NATURE

Vol. 142 SATURDAY, OCTOBER 15, 1938 No. 3598

CONTENTS

	PAGE
Science and National Service	685
Foundations of Human Inequality. By Prof. B. Malinowski	687
Periodicity of Earthquakes. By S. C.	689
Electronic Theory and Organic Reactions. By J. F. T.	689
Scientific Pursuit and Personality. By Dr. Norman R. Campbell	690
High Altitude Cosmic Radiation. By Prof. P. M. S. Blackett, F.R.S.	692
The Old Stone Age in European Russia.	693
Hugh Miller, 1802–56. By T. S. W.	696
News and Views	697
Letters to the Editor:	
Discovery of an Additional *Pithecanthropus* Skull.—Dr. G. H. R. von Koenigswald and Dr. Franz Weidenreich	715
Two Stellar Systems of a New Kind.—Dr. Harlow Shapley	715
Nature of Extensive Cosmic Ray Showers.—Dr. L. Jánossy and Dr. A. C. B. Lovell	716
Magnetic Anisotropies and the Valencies of Paramagnetic Atoms in Crystals.—Prof. K. S. Krishnan and S. Banerjee	717
Relativistic Motion of a Radiating Mass.—Prof. V. V. Narlikar	717
Infra-Red Absorption Spectrum of Sulphur Trioxide.—Dr. H. Gerding and Dr. J. Lecomte	718
CH Bands in the Night Sky Spectrum.—Prof. J. Cabannes, Prof. J. Dufay and J. Gauzit	718
Fatty Acids from Yeast as Respiratory Factors.—Prof. Elton S. Cook and Cornelius W. Kreke	719
Blood Ammonia and the Deaminases of Adenosine and Adenylic Acid.—Prof. Edward J. Conway and Robert Cooke	720
Application of the Feulgen Method to the Study of Viruses.—Dr. C. F. Robinow and Dr. J. O. W. Bland	720
Research Items	722
Function of Education	724
New Science Buildings at Shrewsbury School	725
Effect of Inbreeding of Physiologic Races of Rust	726
Science News a Century Ago	727
Societies and Academies	727

SUPPLEMENT:

BRITISH ASSOCIATION DISCUSSIONS:

Soil Fertility and Agricultural Policy. By Dr. E. M. Crowther	701
Ecology and Afforestation	703
Limestones as Eruptive Rocks	704
Vibration in Engineering	705
Incremental Permeability of Special Steels	707
Organic Chemistry of the Metals. By Dr. F. G. Mann	709
Recent Research in Seismology	710
Educational Significance of the Cinema and Wireless	711
Professionalism in the Modern World	712

Editorial and Publishing Offices:

MACMILLAN & CO., LTD., ST. MARTIN'S STREET, LONDON, W.C.2.

Telephone Number: Whitehall 8831 Telegraphic Address: Phusis, Lesquare, London

The annual subscription rates are: £2 12 0 British Isles, £2 17 0 Foreign, payable in advance

Advertisements should be addressed to

T. G. Scott & Son, Ltd., 63 Ludgate Hill, London, E.C.4. Telephone Number: City 4211

Registered as a Newspaper at the General Post Office

All rights reserved

GERYK HIGH VACUUM PUMPS

ALL BRITISH

45 years ago we introduced the "Geryk"—the first practical mechanical high vacuum pump. Experience has enabled us to produce vacua, formerly unobtainable—e.g., ·01 millimetre off absolute vacua with single stage pumps, or up to ·00001 millimetre with the Duplex pattern.

2 cubic feet per minute is swept by 3-in. pump. Larger sizes up to 110 cubic feet per minute.

New pattern Geryk High Vacuum Pump

PULSOMETER ENGG. CO., LTD.
Nine Elms Ironworks, READING
39 Victoria St., LONDON, S.W.1

Write for LIST 2076

TRADE MARK **Pulsometer** TRADE MARK

CHARLES GRIFFIN & CO., LTD.

JUST PUBLISHED. **Price 25s. net.**

A TEXT-BOOK OF
INORGANIC CHEMISTRY

By J. NEWTON FRIEND, D.Sc., Ph.D., F.I.C.

Volume VI., Part IV.

ARSENIC

By REECE H. VALLANCE, M.Sc., F.I.C

Contents—General Introduction to the Series—Preface—List of Abbreviations—Table of Dates of Issue of Journals—Chap. I. Introductory—II. The Occurrence of Arsenic—III. Arsenic and its Properties—IV. The Metallic Arsenides—V. Arsenic and Hydrogen—VI. Arsenic and the Halogens—VII. The Lower Oxides of Arsenic and the Metallic Arsenites—VIII. Arsenic Pentoxide and the Arsenates—IX. Arsenic and Sulphur—X. Arsenic and Elements of Groups V, IV and III—XI. Physiological Properties of Arsenic Compounds—XII. Arsenical Sprays and Dusts—XIII. The Detection and Estimation of Arsenic—Name Index—Subject Index.

In Medium 8vo. Cloth. Pp. i-xxxi + 351.
Price 25s. net. Postage 6d. inland; 1s. 1d. abroad.

Please send for detailed Prospectus, free on application.

42 DRURY LANE, LONDON, W.C.2

Bausch and Lomb
Estab. 1853

FOR THE LABORATORY

THE MODEL 'H' MICROSCOPE

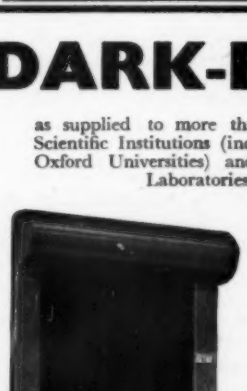
of specially rugged design to withstand the rigours of daily routine and research work. **The microscope is fully covered by the Bausch & Lomb guarantee.**

LIST "LABORATORY MICROSCOPES" ON REQUEST

BAUSCH & LOMB OPTICAL CO. LTD.
Africa House
KINGSWAY LONDON, W.C.2

DARK-BLINDS

as supplied to more than 600 Hospitals and Scientific Institutions (including Cambridge and Oxford Universities) and recently the Kodak Laboratories, Harrow.



ROLLER
London-made Tin-Barrell.

GROOVES
Pat. 2" x 1" all steel side-grooves.

Type N.T.
(100% Light-tight)
Pat. No. 489116

Tel.: Langham 2433 & 1129.

Estd. 100 years.

J. AVERY & CO.

81, GREAT PORTLAND STREET, LONDON, W.1.
(also General and Scientific Blind-Makers)

Editorial & Publishing Offices:
MACMILLAN & CO., LTD.
ST. MARTIN'S STREET
LONDON, W.C.2

Telegraphic Address:
PHUSIS, LESQUARE, LONDON

Telephone Number:
WHITEHALL 8831

Vol. 142 SATURDAY, OCTOBER 15, 1938 No. 3598

Science and National Service

IT was apparent during the recent critical weeks that, though the problem of the utilization of science in war-time had been under consideration, no comprehensive scheme for this purpose was in existence. The immediate danger is now past, but there are clear signs that the peace obtained by consultation is not of a character which will permit of any relaxation of military preparations. The problem thus still remains an urgent one, though we may hope for the time to work out a reasonable rather than improvised scheme. If this is to be done in a way that is not likely to waste the capacities of scientific workers, or to damage the structure of scientific knowledge and research, scientific men will need to take the matter in hand.

In the first place, it must be emphasized that no scheme for the utilization of science can be satisfactory to citizens and men of science unless its ultimate aim—the utilization of science for human welfare in times of peace—is kept steadily in view. The idea which appears to be prevalent in certain countries, that the main activity of human communities is the waging of war and that peace is merely an armistice for future war preparations, is not one which is compatible with the maintenance of civilization or of science. Consequently, the organization of scientific workers for war must be conceived in such a way that the minimum damage is done to the possible beneficial utilization of science. This involves the safeguarding of fundamental scientific research and of the main lines of its application, so that once the danger of war is definitely removed, science can advance as rapidly as possible in carrying out its true purpose. It involves, further, the protection of the life and efficiency of a sufficient number of key scientific workers, and the maintenance of a continuity of scientific teaching and training. It would be found that such provision would not, in fact, be detrimental from the strictly military point of view, and that the effective utilization of science for war purposes requires, to be fully effective, a proper balance between civil and military uses for science, even in war-time.

If we are to face in a realistic way the possibility of war, certain steps should be taken immediately in the organization and the use of science, while others of more drastic character will be needed only if and when war breaks out. Scientific war preparations in peace-time involve two types of activity. The first is the organization and development of basic and applied scientific research in such a way that it may be of value for war without losing its actual or potential peace-time value. The second is the training of a certain number of scientific men, and the preparation of many more, for possible war-time activities.

It is clear that measures that were adequate for the Great War are unlikely to prove so in a future war waged under conditions which will probably be even more severe and prolonged. Preparation for such a war requires not only a much more thorough organization of science, but also a much closer integration between scientific research and the other activities of the community, particularly those of industrial production, agriculture and health.

When we review the potential needs of the British Isles, or the British Commonwealth, in war-time, we see that they are primarily those of maintaining a human community at full effectiveness under conditions of shortage of supplies, shortage of men and of general disorganization due to enemy attack. Most of these are simply the problems of normal civilized life raised to a

much higher degree of urgency; consequently, development of scientific research to cope with these problems is bound to follow in the main the same lines as those required for the proper utilization of science in peace.

The five principal needs of a modern community under war conditions are: (1) maintenance of the military and civil populations; (2) maintenance of war production; (3) defence against aerial attack; (4) the carrying on of military, naval and air operations; (5) care of casualties. Each of these problems makes special demands on certain of the sciences, and requires peace-time development of research on certain specific points. The strain of war conditions is not uniformly felt; it bears particularly hard on certain sectors in which there are deficiencies not perceptible in peace-time. These weak points are those most likely to break, and the breaking of any one of them may entail military defeat, or, what is more likely under modern conditions, economic collapse.

It is impossible to itemize all these weak places, but there are at least six which are of cardinal importance: food, non-ferrous metals, rubber, motor-fuel, optical instruments and medical supplies. For all of these we are dependent to a large degree on imports which may be restricted or cut off altogether. At the same time, they are all products in which an application of science can provide either alternative sources or effective substitutes. If this is to be done, however, it is not only necessary to provide, as at present, for applied research in these fields: fundamental research is just as necessary, provided it is well linked with practice. In the case of food, for example, the work of geneticists, plant physiologists, biochemists and nutrition experts is no less important than that of agriculturists.

Similar considerations apply to the more purely military aspects of war. The defence of the civil population against aerial attack has created entirely new problems. Protection against the effects of high explosives will necessitate a combination of evacuation and construction of shelters, which will involve research in population distribution and in building

The carrying on of military operations is itself a large-scale industrial undertaking. The question of fuel may be a crucial one. Already a great deal of fundamental and applied research has been done on the problem of artificial fuels, but it is still open to doubt whether a more direct attack on the problem, free from the confusion of rival interests, might not yield more economical production of motor-fuel from coal, than at present obtains. Another characteristic of modern warfare is the dependence it places on scientific means of detection and communication. An adequate supply of optical instruments of the highest precision is needed, and this requires a development of the optical industry and of optical research on a scale that has not yet been attempted.

With the new weapons of destruction which have been developed since the last war, and particularly with the bombing of cities, casualties are likely to be heavy and serious. The medical profession will have to face a heavier task than in any previous war. It is difficult to improve technique in dealing with casualties under war conditions, and therefore special efforts in medical research are required in order to prepare new and improved methods of treatment and rehabilitation. Much greater quantities of medical supplies will be required, particularly of drugs, for there is reason to believe that the home production is inadequate even for peace-time. We need at once to develop drug production and research on drugs comparable to that already existing in Germany, and on a far larger scale than the £30,000 provided by the Medical Research Council for chemotherapy allows.

These are some of the more obvious needs that war would bring for applied and fundamental science. There are many others which will be apparent to those working in different fields. But if these needs at least are not dealt with now, by provision and adequate facilities for research on both laboratory and factory scale, the effect of this neglect in war-time will be disastrous. Further, it will be necessary to secure that men trained in the different scientific techniques are reserved for scientific service in war-time, and that the best use is made of the registers now being compiled by the universities, possibly through the collaboration of the learned societies.

The problems which war raises for scientific research are, however, not independent, and demands made for one or another of them would, in the absence of co-ordination, merely increase the existing confusion and inefficiency of research. If science is to be used to some extent for the protection of humanity in war, it needs to be organized more comprehensively than it is at present. This is not to criticize the existing organization of science, but to point out that it requires to be extended and more closely knit. We need a National Research Council covering the whole of

science and relating it to the running of the community both in peace and in war. The French Government has just set up such a council, which is linked with all the defence Ministries as well as with that of national education. This is not the place to discuss precisely how such a council should be formed or how it would group existing organizations, but certain requirements must be satisfied if it is to succeed in its main purpose of utilizing science for national service. In the first place, it will need to command the active loyalty of a great majority of the scientific workers in Great Britain. They will best collaborate with a body which they feel represents the most effective scientific workers, and not simply those chosen on a basis of seniority or official position. Further, at any rate the younger among them, will not work wholeheartedly, if at all, to organize science for a possible war unless they see evidence that the intention of political policy in general is to prevent war. Lastly, if the war should come, their attitude towards it will largely depend on whether it is a war for or against the principles of democracy and civilization.

There are two ways in which the scientific man can be used, under war conditions. One is by putting him in the position of a military subordinate, whose business is to obey orders and not to think. The other is to give him a chance to use his imagination and knowledge co-ordinated with that of his fellow scientific workers and technicians, to criticize and direct, in so far as he is competent, the character of operations. In the first way it is impossible to get the best out of scientific men, even if they are willing to comply with the conditions. Any adequate organization of science cannot relinquish the fundamental scientific right of criticism. Stifling of criticism led to great losses in 1914–18; it might have an even more disastrous result in a future war. The full utilization of scientific workers requires the use of their ingenuity far more than of their routine service, and this can only be secured by giving them opportunities and liberty of initiative. The degree to which this is done may be a decisive factor; and its neglect might mean defeat in which the prospects of reconstruction afterwards would be irretrievably damaged. It is for the citizens and scientific men in the democratic States to see that this does not happen on their side.

Foundations of Human Inequality

The Origin of the Inequality of the Social Classes

By Prof. Gunnar Landtman. Pp. xvi + 444. (London: Kegan Paul and Co., Ltd., 1938.) 21*s*. net.

PROF. LANDTMAN'S book, in spite of certain shortcomings, will obtain a permanent place in anthropological literature as an encyclopædia of fact and theory, on such subjects as the earliest differentiation of society according to age, sex and personality; the role of wealth, manual skill and commercial efficiency in creating primitive stratification; the question of early phases of priesthood, in its dogmatic, social and ritual aspects. The chapters on slavery are valuable as a summary of older work, supplemented by recent evidence. The book deals somewhat briefly in the last two divisions with the genesis of nobility and with the origins of government.

Inspired though it is by the classical tradition of British anthropology, the book lacks the charm and the intuitive genius of Frazer; it falls short of the standard set by Westermarck in his almost uncanny creative acumen in the analysis of fact and its relevance; it has not the flashes of inspiration characteristic of the work of Crawley. At the same time, the sincerity, the thoroughness and the complete impartiality in dealing with facts and theories will allow the reader to draw his own conclusions from the material, conscientiously and skilfully accumulated by the author.

The very quality of the book and its high standard of scholarship invite criticism on one or two points. In his treatment of the origins of government, for example, the author fails in my opinion to recognize some of the relevant aspects of the problem. It is, of course, necessary to discuss whether in certain primitive communities power is vested in a council or a monarch, in a male chief or a queen-mother, handed down by a hierarchy or distributed through a confederacy. Another important question, however, still remains: In what way do the rulers of primitive peoples carry out their work? And, indeed, in what does this work consist? Do they ever take any legislative initiative, or is custom regarded as unalterable? In what way are their administrative functions carried out—through specific executive

organs, a tribal police, the chief's henchmen, or by magic and sorcery? An analysis of primitive government might have considered such aspects as legislation, jurisdiction and administration, as well as its fiscal, magical and military functions.

This substantial side of the problem is scarcely touched upon. Prof. Landtman gives us almost exclusively the structure, or the form, of early government. The question of its scope and functions is interesting, for here we have apparently considerable differences according to area. In Melanesia, where I studied it at first hand, the actual sphere of activity of chiefs, councillors and officials is very limited. They do not act as rulers, but rather as political masters of ceremonies. The actual rule is exercised by custom. The chief acts as mouthpiece of the traditional routine, in war and in economic activities; in the interpretation of legal rules and their application. In Africa, on the other hand, the initiative and executive power of the rulers is apparently much wider and more substantial. In a comparative study like the present one, it would have been of great value if the author had revealed the common measure as well as the variations in the actual work of early government. The problem is not merely theoretically important, but also has actual practical relevancy under systems of indirect rule, and, indeed, in all cases where colonial policies are being framed or overhauled.

Again, the practice of starting with a definition, instead of letting it grow out of the material collected, might be questioned. Thus when, after a very useful review of older theories and definitions of slavery, the author tells us that slaves are "an unfree class which, occupying the lowest rank in human communities, are more or less entirely subject to the power of their masters" (p. 229), it seems that from the substance of his subsequent analysis a much better definition could have been framed. For it might have been given not only in the somewhat general terms quoted, but also in summing up the main characteristics of slave labour; of the position of slaves in their freedom to marry and reproduce; in terms of legal status and political disabilities.

As a follower of Rousseau, Prof. Landtman endorses A. R. Wallace's opinion that "among people in a very low state of civilization, we find some approach to such a perfect social state". *Perfect* here seems synonymous with *equality, homogeneity, lack of oppression* and *plenty of food and simple commodities*. For Prof. Landtman tells us that "Not only the non-existence of social ranks but certain other features of the life of undeveloped native tribes undoubtedly suggest attributes of the utopian social state of philosophy. Such is the high moral standard of some of these tribes and, above all, such the seemingly happy and untroubled life some of them lead surrounded by a luxurious tropical nature. No wonder that they have acquired the admiration of so many enthusiastic travellers" (p. 4). As a corrective to the constantly reiterated statements describing the primitive as "fear-ridden", "witch-haunted", "paralysed by anxiety neurosis", or "living in debauchery and sexual promiscuity", such a view is a welcome exaggeration of the opposite aspect of primitive life.

As a matter of balanced fact, however, the stone-age man of to-day fits neither into the pages of Rousseau nor into those of Hobbes. He is neither primarily happy nor panic-ridden; neither virtuous nor infected with vice and cruelty. In extremely small groups, with a limited range of interests and activities, we cannot look for cultural phenomena, fully fledged, formalized, and with a strongly pronounced moral physiognomy. Under such conditions, it depends very largely upon the subjective stress given by ethnographer or scholar in one direction or the other, upon some minute touching up, whether the Bushman, the Negrito or the Australian aborigine emerges as a happy child of Nature or a miserable savage, witch-haunted, starved and bloodthirsty.

The simple *yea* or *nay* approach is not sufficient. We have to search in the confused and uncrystallized beginnings of social and mental life, and look for the manner in which law and order, rank and class differentiation, though but partly formed, yet do their work and achieve their results. We have to establish the early forces and foundations of such permanent aspects as economics, political rule, administrative and legal order, education and religion.

As regards all such problems within the sphere of early social differentiation, the present book will prove an excellent compendium of fact and information. In his actual handling of most problems, Prof. Landtman writes not as a follower of Rousseau, nor of the doctrines of Marx, Durkheim or Hegel, but as an impartial man of science, one of the world's foremost field-workers, and with a sound theoretical outlook derived from the unimpeachable teachings of Westermarck.

The greatest merit of all original contributions to a new subject-matter is to provoke thought and even criticism, as well as to provide the material with which this can be substantiated. Thus even my critical remarks are a tribute to the value of the book. It will remain a standard treatise on the somewhat neglected, and nowadays perhaps most important, problem—that of human inequality, of the possibilities of a 'classless society', and the organization of rank and power.

B. MALINOWSKI.

Periodicity of Earthquakes

Studies on the Periodicity of Earthquakes
By Dr. Charles Davison. Pp. ix+107. (London: Thomas Murby and Co., 1938.) 13*s*. 6*d*. net.

"When the earth's crust, or a portion of it, is on the point of making one of those sudden movements that result in earthquakes, a very slight force acting in the same direction may precipitate the movement. On the other hand, the same type of force acting in the opposite direction may be sufficient to delay its occurrence. If the magnitude of the force, in whichever direction it acts, is subject to a periodic variation, as in annual or diurnal changes of barometric pressure, the same, or a contrary, periodic variation may thus be impressed on the frequency of earthquakes in any district. The study of the periodicity of earthquakes may therefore throw light on both small and great movements of the crust . . ."

THESE opening words from the preface of Dr. C. Davison's new book clearly indicate the motive that prompted this veteran worker on earthquakes to undertake one branch of his extensive seismic studies. Much might be written on the mechanical questions involved in these prefatory remarks, without invalidating the legitimacy, in our present state of ignorance, of inquiry into the periodicity of earthquakes. Such an inquiry forms a natural complement to the author's long and valuable work in collecting and cataloguing particulars of the earthquakes that occur both in the British Isles and throughout the world as a whole. His book summarizes and extensively revises (with the aid of many new catalogues) the conclusions on earthquake periodicity that he has published in many articles during the past forty years and more.

The periods Dr. Davison has been led to consider range from forty-two minutes, through diurnal and annual intervals, to eleven and nineteen years; a chapter is devoted to each supposed period. The brief opening chapter describes the method employed, and the test of reality adopted, which is one given by Schuster; the author states that the test may be, and often has been, misapplied, but is himself convinced that as he applies it, it establishes the reality of the periods studied in each of his chapters. In his concluding chapter, he discusses how the results he obtains throw light on the movements of the earth's crust.

Those who know most about the pitfalls that beset statistical studies, not least in geophysics, will probably feel that Dr. Davison's conclusions should be taken as a new starting-point, rather than as the end, of this line of investigation. Not the least valuable feature of his book is the long list of (131) catalogues of earthquakes on which his studies have been based, and which will facilitate new studies of the same data, as, for example, by the methods that Bartels has developed, wherein, in particular, 'quasi-persistence' is taken into account. S. C.

Electronic Theory and Organic Reactions

Modern Theories of Organic Chemistry
By Dr. H. B. Watson. Pp. viii+218. (Oxford: Clarendon Press; London: Oxford University Press, 1937.) 15*s*. net.

A BOOK such as that under review was certainly wanted in order to co-ordinate the various modern theories applied mainly to organic chemical reactions. Thus, after a general article on theories of chemical combination—a theme which has occupied the minds of chemists from the earliest days and will do so for many years to come—the author passes on to deal with the new physical methods of investigation, and devotes many pages thereafter to a general discussion of the subject, mainly of the electronic theory as applied to organic reactions. Although Robert Robinson gave a very concise and clear account of this theory in his lectures at the Institute of Chemistry in 1932, the work which has been done since needed the hand of a ready writer, in order to co-ordinate the details in a manner capable of being understood by those who are not physically minded. The desired co-ordination is provided in this book, and the author is to be congratulated on the way in which he has achieved a most necessary task.

Nevertheless, it must be admitted that except in the instance which may be termed "The Royal Institution Case", the theory has not yet proved sufficiently quantitative to enable it to predict. It still relies too much on what is known and on what, indeed, has been recognized and provided with

other forms of nomenclature, in the past. The positive negative cause of all chemical reactions has been the basis of discussions of interacting molecules for generations past. What we require of the new theory, and what it has not yet developed to the full, is a quantitative aspect which will give direction and not merely offer an explanation of what is known. No doubt, however, this development is only a question of time, and the research worker will at some future date be able to tell with certainty whether an organic reaction will 'go' or not. Then, and then only, will the investigator save the time and expense caused by the 'cut and try' method of research, a method which is perhaps more common than many purists will admit.

The chapter on "Free Radicals" is also one of considerable interest. That the combination of organic residues to form more complex molecules occurs is clear, but what is lacking in this method is direction. When the simplest cases are investigated, that is, for example, those cases in which only two free radicals are concerned, all is clear. It is only when several such free radicals are involved that the issue seems to be entirely adventitious and may be likened to a dog fight. It is foolish to dogmatize in these matters, but it seems unlikely that, except in specific cases, this method of research can lead to any form of prediction open to serve any useful purpose.

The article on tautomeric change is admirable, and will repay reading, as will also the chapter on "The Beckmann Rearrangement" and those on several other topics of the day.

The book is well presented and well written throughout, and contains just those matters which the chemist as such, apart from the specialist, wishes to know. To the specialist himself it will act as a stimulant and an incentive. J. F. T.

Scientific Pursuit and Personality

Scientists are Human

By David Lindsay Watson. (The Library of Science and Culture.) Pp. xx+249. (London: Watts and Co., 1938.) 7*s.* 6*d.* net.

IN his foreword, Prof. Dewey says that "Dr. Watson is concerned to show that the pursuit of science and the products of science are relative to the mental world of the scientist, to the organization of his personality in all its phases, and that this in turn is relative to the social organization that subsists". That is surely a commonplace nowadays; the only dispute left is that between liberals and communists concerning the relative importance of personality and social organization.

Dr. Watson is very definitely liberal; indeed, he scarcely seems aware that the communist view is held seriously. The first part of his book is directed to an inquiry whether the social organization that subsists in the United States is favourable to the personality of those possessed of true scientific originality. He concludes that it is not. I am quite incapable of offering any opinion concerning the matter, because the conditions he takes for granted in America do not prevail in Great Britain. We doubtless suffer from our own evils; but our universities do not, I think, over-value "drawing-room standards"; nor would eccentric genius find its spiritual home here in an industrial rather than in an academic institution.

But even an American reader might criticize Dr. Watson's analysis. He seems to assume that scientific genius is always associated with the same kind of personality, and that conditions adverse to one genius must be adverse to all. This is by no means obviously true; it is difficult to imagine a state of society that would be congenial both to a Cavendish and to a Rutherford; it is equally possible that almost any state of society will encourage some type of scientific genius. Moreover, Dr. Watson's arguments are difficult to follow. He is obsessed with neglected geniuses; but whatever were the reasons why Fresnel and Mendel did not receive their full recognition, they were certainly not the machinations of the "good executive" to which (I understand) all American evils are due. Again, the fact that Dr. Watson thinks that certain of his contemporaries are neglected surely does not prove that they are geniuses; the judgment of contemporaries is *sometimes* right. It is all very puzzling.

The rest of the book is concerned with the denunciation of certain fallacies that, according to Dr. Watson, vitiate much of modern science. (Whether they too are due to the "good executive" is not clear.) The difficulty here is to discover who entertains these fallacious doctrines; for whenever Dr. Watson quotes a scientist (even myself!), he does so with approval. Moreover, the true gospel, as he expounds it, does not seem to be very novel; it appears to be made up of selections, not always self-consistent, from all the chief writers on scientific principles and methods. I am sorry to be so disparaging, for Dr. Watson's theme is interesting; but his personal grievances appear to have got the better of his judgment.

NORMAN R. CAMPBELL.

The Doctor's View of War

Edited by Dr. H. Joules. Pp. 123. (London: George Allen and Unwin, Ltd., 1938.) 3*s.* 6*d.* net.

THIS admirable little volume has the strongest claims on the attention of all scientific workers. Dr. Joules and his colleagues give a concise but lucid account of the service which the doctor can render in time of war, and the problems he has to face, as well as of the effect of the disregard of the Red Cross emblem in recent years. Much more than this is, however, provided. An ably written chapter deals succinctly with the biological effects of war, and argues that it is doubtful whether a differential mortality between different groups would be great enough to have any evolutionary significance within a short time. It is considered rather that modern war would wreck the present structure of society without any permanent biological damage having been inflicted.

It is, however, for the stimulating and highly suggestive chapters which deal with the professional responsibilities of the doctor towards the State and in the defence of the civilian population that scientific workers should be most grateful. What is written here of the medical profession is equally true of scientific workers of other groups, and the problems which face a professional association in relation to the State and the responsibility that such associations must bear for independent investigation and criticism are admirably presented. If the volume did no more than arouse scientific workers to the responsibility that they must bear in this way for conserving the fragile life of our democratic institutions it would be welcome. It issues, however, a call to wider action on an international scale to eliminate the causes of war, and the responsibility of the doctor or other scientific worker as a private citizen for supporting a foreign policy which insists on such preventive measures is firmly urged. Equally it is urged in conclusion that the medical associations of different countries should take their own collective action to assure ordered scientific progress, nationally and internationally conceived and practised, and that the relations of the profession to the State should be based upon a series of well-defined principles.

These Amazing Electrons

By Raymond F. Yates. Pp. xiii+326+46 plates. (New York: The Macmillan Co., 1937.) 16*s.* net.

THIS volume merits serious consideration as an attempt to popularize science, with proper emphasis on its social significance. It is not a mere book of wonders (although they are in it), but an accurate and well-illustrated account of the principles and applications of electronics. The development is not superficial, but it should be possible for anyone to follow it easily who has no more initial knowledge of electricity than is required for the use of ordinary domestic electrical apparatus. Mr. Yates's style is vivid, almost racy, and will probably irritate an academically trained physicist; but it is unlikely to disturb the average lay reader.

Advanced Algebra

By Clement V. Durell and A. Robson. Vols. 2 and 3. Pp. xi+195–510+xxiii–xlvi+4. (London: G. Bell and Sons, Ltd., 1937.) 12*s.* 6*d.*

THIS book, comprising vols. 2 and 3, is intended to complete the school course and to provide a suitable introduction to higher work for those who are proceeding to the universities. Attention has rightly been concentrated upon fundamental principles and methods which are essential to a more advanced study of modern mathematics. Vol. 2 deals with finite series, difference equations, complex algebra, partial fractions, theory of equations, sequences and convergency. In vol. 3, the student is introduced to those parts of the subject which are of special significance in the modern developments of mathematics—inequalities, determinants, matrices, elementary probability and the theory of numbers.

Throughout, the text has been prepared with much skill, thoroughness and clarity; the methods are up to date and admirably adapted to lay a sound foundation for further study. There is also an abundance of exercises for the student, and these are roughly divided into two groups, the first consisting of straightforward applications of the bookwork, and the second of carefully graded sets of more difficult problems. The book should be very useful, and especially to those who intend to specialize in mathematics.

Engineering Electronics

By Donald G. Fink. Pp. xiii+358. (New York and London: McGraw-Hill Publishing Co., Ltd., 1938.) 21*s.*

THE author, who is managing editor of the well-known journal *Electronics*, is in an ideal position for observing the continuous and successful application of electronic devices to industry. Without the subtlety associated with the specialist and research worker, or even a professor, and taking a robust point of view, he has produced a well-balanced text covering ground which has indeed been covered before, but not in a way that a practising engineer can, and ought to, understand. Sufficient theory of electrons in vacuum and gas tubes is included to make the internal and external circuit phenomena of these intelligible. A large number of electronic problems serve to illustrate magnitudes and the possibility of practical use of controls.

L. E. C. H.

The Climates of the Continents

By W. G. Kendrew. Third edition. Pp. xii+473. (London: Oxford University Press, 1937.) 21*s.* net.

THE third edition of Mr. Kendrew's book does not bear any striking outward marks of differing from the earlier editions, but many minor emendations have been made, both in the text and in the tables. The book remains, as before, the most useful and convenient collection of climatic data available in the English language, and not the least of its virtues is that it gives data for the whole world in one set of units.

High Altitude Cosmic Radiation*

By Prof. P. M. S. Blackett, F.R.S.

VERY great advances have been made during the last year in the understanding of the complicated phenomena of cosmic radiation. One of the most important steps has been the experimental verification of the validity of the predictions of the quantum theory of radiation up to very high energies. The application by Heitler of the quantum theory to the collisions of energetic electrons with atoms, and also the semi-classical treatment of the same problem by Williams and by Weizsäcker, show that energetic electrons are rapidly absorbed in matter by the emission of energetic photons, and further that the photons are equally rapidly absorbed by the production of pairs of positive and negative electrons. The combination of these two processes leads to the cascade theory of showers, which was developed independently by Bhabha and Heitler, and by Carlson and Oppenheimer. When an energetic electron traverses an absorber, it gives rise, by successive acts of photon emission and pair production to a large number, and for very energetic electrons, to a very large number of positive and negative electrons and photons. Eventually the loss of energy by ionization brings this process to an end, leading after the first building up of a shower to its eventual absorption.

This cascade theory of showers was found to explain in a very satisfactory manner the behaviour of the soft component of the cosmic rays in the atmosphere, in particular the measurements at high altitudes by Regener and by Millikan and their co-workers. The theory was also able to explain many of the features of the much studied transition curves of showers and bursts in dense materials, which were first investigated by Rossi and Hoffmann respectively. The details of the building up of cascade showers can be seen in cloud photographs; some taken by Street and Stevenson are especially notable in this respect.

Once the validity of the quantum theory for electrons with energies of 10^{10}–10^{11} electron-volts had been established, it became certain that the penetrating rays, which are in the great majority at sea-level, must consist of a new type of particle with a mass intermediate between that of an electron and that of a proton. The possibility that the penetrating component might consist of a new type of particle had been discussed by Auger in the course of a detailed discussion of the widely different properties of the hard and soft components.

Neddermeyer and Anderson[1] first put forward strong evidence that the penetrating rays consisted of particles which had a mass intermediate between that of electrons and protons. Cloud photographs taken by Anderson, Street, Williams, Brode, Ehrenfest and others have shown that the mass of the new particle is probably of the order of 150 times the mass m_e of an electron.

Once the experimental existence of the new particle had been established, great interest was aroused in a theory of nuclear forces put forward in 1935 by Yukawa[2], in which he had postulated the existence of particles with a mass of about 100 times the electronic mass in order to explain the short-range nuclear forces, by assuming that this field was related to the emission and absorption of such hypothetical new particles in a similar way to that in which the coulomb forces between electrons and nuclei are related to the emission and absorption of photons. On this view, the range of the nuclear forces, which is of the order of the classical radius r_e of the electron, and so the size of the fundamental heavy particles, is essentially related to the mass of the new particle through the relation $\lambda = \hbar/\mu c$, where λ is its Compton wave-length and μ is its mass. If $\mu \sim 137\, m_e$, then $\lambda \sim r_e$.

In order to explain β-decay, Yukawa assumed further that the new particle interacted with electrons and neutrinos. It followed that the new particle, if it existed in the free state, must be itself β-active, that is, it must disintegrate spontaneously into an electron and a neutrino, with such a probability that its mean time of life, when at rest, is given by

$$T_0 = 3\hbar^3/g^2\,\mu c,$$

where g is Fermi's constant of β-decay. Taking $g \doteqdot 4 \times 10^{-17}$ and $\mu = 200\, m_e$, we get $T_0 \doteqdot \frac{1}{2} \times 10^{-4}$ sec. When moving very rapidly, the particle will live longer owing to the relativity change of time scale, as pointed out by Bhabha[3], and so will have a mean time of life $T = \gamma T_0$, where $\gamma \gg 1$, and is the ratio of the total energy of the particle to its rest energy.

The predicted instability of these particles provides an immediate explanation of the curious fact that had been deduced from the observations by

*Introductory address at a symposium in Section A (Mathematical and Physical Science) of the British Association on August 20.

several workers, that there are apparently no penetrating particles incident as primaries on the top of the atmosphere; on the new theory they would, of course, have disintegrated in space before reaching the earth. Recently, Heisenberg and Euler[4] have shown how the spontaneous decay of the new particle can explain the striking, but hitherto inexplicable, failure of the mass absorption law for the penetrating rays in air and in dense materials.

By observations at ground-level and in the 'tube' station at Holborn, Follett and Crawshaw[5] found that the intensity of the rays under a large thickness of air was about one half that found under the same mass of clay. Ehrmert[6] found a similar discrepancy between the absorption by air and by water. The effect was studied in considerable detail by Auger[7] and his co-workers, who obtained results which can be interpreted as showing the greater absorption of air at low pressure compared with air at normal pressure.

Heisenberg and Euler show how such observations can be explained quantitatively by the spontaneous decay of the new particle. This follows from the fact that in air the distance travelled by the particle during its mean time of life is rather less than its range as defined by its ionization loss, whereas in dense materials the latter range is very much the smaller. Thus in air the decay increases the apparent absorption, while in dense materials it has little or no effect.

A simplified form of the calculations of Heisenberg and Euler shows clearly how the order of magnitude of the time of decay can be obtained from the observations. For example, from the measurements of Follett, or of Ehrmert, it can be seen that the intensity under 60 m. water-equivalent of air is about a half that under the equivalent thickness of clay or water. We conclude, therefore, that one half the rays decay spontaneously in the time required to traverse 60 m. water-equivalent of air, that is, a distance of about 60,000 m. The mean time of life T is therefore of the order of $6 \times 10^6/3 \times 10^{10} = 2 \times 10^{-4}$ sec. Since the value of γ for the rays, assuming a mean energy of 10^{10} e. volts and a mass of 200 m_0, is about 100, we get $T_0 = 2 \times 10^{-6}$ sec. Though this value is about four times that predicted by Yukawa, the agreement must be considered as most satisfactory in view of the early stage of the theory and of the crudeness of the deductions from the experiments.

There seems, therefore, to exist definite experimental evidence for the spontaneous decay of the new particle. The accurate determination of this time of decay and of the mass of the particle is now one of the outstanding problems of cosmic ray research. It is possible, of course, that there are other methods than that of spontaneous decay by which the new particles may disappear, but further experimental results are needed before any certainty can be attained on this point. Since there can be no particles of this type incident on the atmosphere, they must all be produced in the atmosphere as secondaries to the incident electrons. No evidence as to how this occurs has yet been found.

[1] Neddermeyer and Anderson, *Phys. Rev.*, **51**, 884 (1937).
[2] Yukawa, *Proc. Phys. Math. Soc. Japan*, **19**, 1084 (1935); Yukawa and Taketani, M., *ibid.*, **20** (1938).
[3] Bhabha, NATURE, **141**, 117 (1938).
[4] Heisenberg and Euler, in the Press. (I am greatly indebted to Prof. Heisenberg and Dr. Euler for communicating these new results to me.)
[5] Follett and Crawshaw, *Proc. Roy. Soc.*, A, **155**, 546 (1936).
[6] Ehrmert, *Z. Phys.*, **106**, 751 (1937).
[7] Auger, Ehrenfest, Fréon and Fournier, *C.R.* **204**, 257 (1937).

The Old Stone Age in European Russia*

ARCHÆOLOGISTS are generally agreed as to the importance of obtaining more precise and detailed information about the actual conditions of the cultural stages of eastern Europe, of which the greatest part is European Russia. At the same time, the total of information relating to the palæolithic period in that region, which has appeared in English, French and German, is negligible; and knowledge of the period is far from satisfactory. Dr. Golomshtok, accordingly, at the suggestion of Mr. H. H. F. Jayne, director of the University Museum of Pennsylvania, with the assistance of the Board of Managers of the Museum, and a grant from the National Research Council, has brought together all the data available, regardless of the language of publication, but so far as possible endeavouring to present the first-hand evidence of the excavator. Some idea of the importance and magnitude of his undertaking will be gathered from the fact that while Burkitt lists nine sites, MacCurdy fourteen, and Ebert and Menghin six and seven respectively, the present survey, which, it is pointed out, is not to be regarded as final, covers no fewer than 105 sites, to which must be added eight sites on which human remains have been found, without artefacts, but

* "The Old Stone Age in European Russia". By Eugene A. Golomshtok. *Trans. Amer. Phil. Soc.*, N.S., **29**, 2, March 1938. Pp. v+191–468+xxxvii plates.

in association with a fossil fauna, or otherwise dated.

In the history of palæolithic studies in Russia up to 1917, the first site discovered was Gontzi in the Poltava region, where fossil bones in association with a flint implement attracted the attention of Kaminsky, a local teacher, in 1874. Three years later, Count U. S. Uvarov, the father of Russian prehistoric archæology, established the existence of a palæolithic site on his estates near the village of Karacharovo; and in 1879 his collaborator, Poliakov, discovered Kostenki I, one of the most important sites in Russia. The visit of K. S. Merezkovski, a botanist, to the Crimea resulted in the discovery of a number of cave sites, Suren I, Cherkess-Kermen, etc.; while from 1880 onward palæolithic cultures were determined in the Dnieper region (Antonovitch), Nova-Alexandria (Kristaphovitch), Tomsk (Kaschenko), Cyrill St., Kiev (Khvoiko), and Ilskaya in the Caucasus (Baron de Baye). Uvarov and Volkov, by their summaries of existing knowledge, and the latter also by training young archæologists in his excavations at Mezine (1908), placed palæolithic researches in Russia on a truly scientific basis. Among Volkov's pupils, P. P. Ephimenko is the most distinguished archæologist in Russia of to-day.

Under the Soviets, archæological studies have received a tremendous impetus, and the interest of the general public has been much enhanced. Old sites have been re-examined and new sites opened. In 1922, Zamiatnin discovered and examined Borshevo, near Kostenki, where also he excavated new sites. Important investigations have been carried out by G. A. Bonch-Osmolovsky among others in the Crimea. In Siberia, extensive studies have been made in the Yenisei district and in the region of Irkutsk; while archæology has been supplemented by a more detailed study of quaternary geology and palæontology by Pavlov, Gromov and others. The only survey of this work hitherto in a language other than Russian is by L. Sawicki; but it is in Polish.

The materialistic interpretation of history now followed under the Soviets requiring the investigation of every factor that influenced culture, expeditions have studied, alongside the archæological and ethnological data, local geology, fauna, flora and climate. Microscopic examination of charcoals have afforded much information as to flora and climatic conditions.

Russian students of the development of culture, being firm believers in the evolutionary materialistic explanation of cultural changes, are strongly opposed to the theories of cultural borrowings and migrations of Western archæologists, as well as to the antiquarian attitude of interest in antiquities *per se*, which forgets the people who made them. Again, Russian archæologists claim that their statistical and functional methods of study have, on one side, saved them from laying undue stress on 'leading' types, which give a distorted view of the culture, and on the other they have been led to such discoveries as those of underground dwellings of palæolithic man, which have been overlooked in the West.

Before turning to archæological discovery, the conclusions of recent geological and palæontological investigations may be summarized as follows: The existence of three, and only three, definitely traceable glaciations has been established. These are Mindel, Riss and Würm. The Gunz was very weak and either its traces were obliterated by subsequent advances of the ice, or it was not effective. The other three glaciations appear to correspond in time and in general characteristics with those of western Europe. The fauna which accompanied the various climatic changes generally corresponds to that of western Europe, but on the whole has a colder character. The extremely warm species are few and not abundant. The Crimea and Caucasus show local variation.

The discovery which has probably attracted most attention among Western archæologists in the post-War years is that of the human skeletal remains, generally known as the Podkumok skull, from the Caucasus. These remains were found in the autumn of 1918 in the course of excavations for a sewer in the town of Piatigorsk. They were below a pottery vessel and a polished stone perforated disk; but owing to political conditions, no observations of the exact position of the human remains was possible. Later the remains were dated on the basis of general geological conditions resulting from a survey by P. V. Rengarten. According to this, the find was in the fifteen-metre terrace of boulder clay deposits on the left bank of the Podkumok River. General conditions for the North Caucasus show three terraces at 15 m., 60 m. and 120 m. respectively, all belonging to the Quaternary Age. On this showing the Podkumok find belongs definitely to the Würm glaciation.

The Podkumok remains are part of a cranium consisting of almost the whole of the frontal bone, the front parts of both temporal bones and a small part of the nasal bone, a fragment of the right side of the lower jaw with five teeth, and some other fragments of the skull and skeleton. The bones are thin and small and the muscular attachments weak. Gremiatsky identifies the remains as those of a female of from fifty-five to sixty years of age of the Neanderthal group, but showing an approach to *H. sapiens*, which would place it between Neanderthal and 'modern man'.

While Gremiatsky holds that this find definitely establishes the existence of Neanderthal man in

the Caucasus in conditions very similar to those of the diluvial period of western Europe, there has been a disposition recently in Russia to question the Neanderthal affinities of Podkumok, while Sir Arthur Keith, it is noted, has expressed the opinion that it is altogether of the neanthropic species.

In this connexion, it is to be remarked that the biological conception of the development of man favoured by Soviet archæologists pictures that development as one uninterrupted chain of evolution, and the view of Western archæology, that the Neanderthal race died out and was replaced by a new Cro-Magnon race, is vigorously denied. Cro-Magnon is considered to be a direct descendant of Neanderthal man; and it is held to be even possible that this transformation may have taken place in Europe.

A number of human cranial fragments have been found with fossil bones of an extinct fauna at several sites on the Lower Volga. Of these the most considerable are known as Undora I and Undora II, from the island of that name, on which they were found. The skulls have been reconstructed by A. P. Pavlov, and classified by him as belonging to a group which includes Galley Hill, Brünn and Canstatt, of early post-glacial date.

The dating and interpretation of cultural finds by Soviet prehistorians are often founded on certain basic assertions, which lead to important divergences from the views held by Western archæologists. The acceptance of the universal evolutionary scheme of cultural development, with the material basis as the main determinant, results in a fairly well outlined succession of the phases of social structure, corresponding to the different stages of industrial development. The centre of gravity lies in the method of production, and strenuous objection is taken to 'migrations', 'borrowing' and 'superior races'. This view, however, leads to certain difficulties and inconsistencies. Ephimenko, for example, when faced by certain very primitive characters in Neanderthal man, attributes them to the degeneration which arose from close interbreeding in the small Neanderthal group. Yet on the other hand, the relatively poor industry of the Mousterian group is taken as a proof of the tenacity and ingenuity of Neanderthal man.

To account for the superior physical characters and industry of Cro-Magnon man, it is argued that new conditions of existence changed the character of the social structure, creating, in place of the closed primitive horde, more complex groups of intercommunicating hordes. Hence arose rapid cultural growth and the formation of a new physical type, which entered the history of Europe during the Upper Palæolithic period as the Cro-Magnon race. This view, it is only fair to say, is not accepted by all Soviet archæologists. Bonch-Osmolovsky maintains that while Neanderthal man differed physically from modern man, these differences were such as to limit his functional possibilities. Thus the structure of his hands prevented him from making long knife-like blades, which required a very accurate blow for their detachment. Hence Neanderthal man and Cro-Magnon man represent stages in the process of perfection, which are the result of physical changes dictated by the gradual development of social life.

On summarizing the material from the one hundred and thirteen localities listed, certain generalizations are seen to emerge. European Russia would appear to be very poor in remains of Lower and Middle Palæolithic cultures. No true Chellean and Acheulean sites are found. Two accidental finds of *coups-de-poing* are doubtful; but a series of Acheulean sites reported in the Caucasus by Zamiatnin may change these conclusions, when data are available. The so-called 'pre-Mousterian' cultures, such as are found in the lower layer of La Micoque and La Ferrassie, are represented by the lower layer of Kiik Koba. The dating of this site, however, is far from settled. The upper layer is regarded as pre-Mousterian or archaic Mousterian. Transitional between Middle and Upper Palæolithic, corresponding to Abri Audi, is Shaitan Koba. These sites are dated by Gromov as from Riss-Würm to the maximum of Würm.

In the Upper Palæolithic, there is an absence of stratigraphical evidence of distinctly different cultural layers. In the cave sites of the Crimea and the Caucasus, where geological evidence is lacking, it is frequently necessary to rely on analysis of the faunal complex. The bulk of Upper Palæolithic sites are open camp sites of hunting peoples. In these, two cultural complexes can be distinguished. The first of these complexes consists of large accumulations of animal bones, very much like the well-known bone piles from Předmost, Moravia. As a rule they contain very few stone implements. The second complex, according to most Russian archæologists, represents the place of more or less permanent habitation of these hunting groups. It is characterized by red pigmentation of the ground, due to the presence of ochre, the remains of open fires, filled with ashes and charred bones, and usually by large quantities of stone and bone tools. In several cases, definite traces of permanent habitations were found, sometimes with stone slab foundations, well preserved fireplaces, copings, niches in which objects were kept, and caches of flint and bone tools. Nearby were storage pits and primitive 'ovens'.

The flint industry of the Russian Upper Palæolithic presents almost every variety of form known

to western Europe, except the very specialized classical 'Solutrean'. The 'leading' bone forms, such as the Aurignacian cleft base and harpoons, are totally absent. Consequently an entirely new set of criteria for dating is necessitated; and the subdivisions of Upper Palæolithic industries are employed with different implications. Aurignacian, Proto-Solutrean, Solutrean and Magdalenian are used to designate stages in the development of culture, rather than specific cultures. Thus bifacial flaking and the *point à cran*, even in its most atypical form, are taken as indicating Solutrean temporal affinities. Taking this as the middle point, industries where these characteristics are less prominent are taken as older, that is, as Aurignacian; others which show a general decadence of technique are said to be younger, that is, Magdalenian. Hence Ephimenko finds true Aurignacian in one site only, Suren I. The rest of the Upper Palæolithic sites, excluding the transitional with microlithic industries, he classifies as Aurignacian-Solutrean and Solutrean-Magdalenian, affirming that no true Solutrean sites are known in Russia.

Basically, we seem to have in European Russia the Early, Middle and Late Upper Palæolithic industries, all characterized by the blade technique, which starts very much like the Aurignacian in western Europe, develops, acquires some peculiar traits, suggesting Solutrean influence, and then slowly degenerates, finally reaching the stages of a microlithic industry.

Hugh Miller, 1802-56

Commemoration at Cromarty

THE rise of geological knowledge in the first half of last century was marked by the appearance of innumerable books dealing with the rich mass of observations which could be made by even superficially interested persons. Most of these books are wisely forgotten; but in the residue there are some of the strongest foundations of the present science. One stands out among the greatest, both in content and in its influence on others: "The Old Red Sandstone, or New Walks in an Old Field", by a man who was proud to be a journeyman mason. Buckland said that "geologists were amazed and delighted" by this book, and his phrase must be echoed to-day, almost a century later.

Hugh Miller wrote other books, many of them dealing with geological topics, but "The Old Red Sandstone" seized popular imagination and made this perhaps the most widely known geological formation. He had a few comments on the geology of his native Cromarty in "Scenes and Legends of the North of Scotland", which was appreciated by distinguished critics for its literary qualities. "The Old Red Sandstone" was published serially in 1840 in the *Witness* newspaper, of which Miller was editor; it appeared as a book in 1841. "Footprints of the Creator, or the Asterolepis of Stromness", followed in 1847 as a reply to the "Vestiges of Creation", in which Chambers had published anonymously an evolutionary theory. Miller's answer was, in its time, a remarkable and able contribution to Christian apologetics. He dealt further with the hotly debated frontier-territories of science and religion, in "The Testimony of the Rocks" (1857), which received its final corrections on the day of its author's death; and in the same year was published "Voices from the Rocks; or Proofs of the Existence of Man during the Lower Palæozoic Period", which is now best forgotten. Posthumously, in 1858, Symonds edited the manuscript of "The Cruise of the Betsey . . .; with Rambles of a Geologist", which, in my opinion, contains the most delightful prose of all Miller's output. Other less important geological books and papers, besides other works, came from his pen.

To Hugh Miller geology was an incident in the revelation of religion, but he was usually a shrewd and accurate observer who faced the deductions which he could make from the facts of his observations. In the dedication to "Footprints of the Creator" he wrote: "The ingenious and popular author [Chambers] whose views on Creation I attempt controverting, virtually carries his appeal from science to the want of it. I would fain adopt an opposite course." He was a strong believer in the notion of successive creations, and the great profusion of fossil fishes in the nodule-beds which occur at certain levels in the Middle Old Red Sandstone of the Moray Firth led him to describe these horizons as "platforms of death". For some time his efforts were directed to reconciling Biblical and geological knowledge, and in the atmosphere of nearly a century later it is not always easy to estimate the influence of these attempts.

His indignation was powerfully aroused by two

things—the clearings in the Highlands, during which large sections of the crofter population were packed off to the colonies; and the system of patronage then prevalent in the Church of Scotland. Some tracts published in 1839 made a very deep impression, and in 1840 he was persuaded to become editor of the *Witness*, the organ of the non-intrusionist party. His energies had found a congenial outlet, and his conduct of the newspaper played a great part in the events which led to the formation of the Free Church.

The scientific content of Miller's geological work is perhaps magnified by his literary qualities, but it can stand on its own merits. It must be remembered that very little was known at that time of the comparative anatomy of *living* fishes, and it is not at all remarkable that Miller made several mistakes in his accounts and reconstructions of the curious fishes of the Old Red. But these were mistakes in the interpretation and synthesis of a great number of new, accurate observations which he made on the actual fossils. Sir Archibald Geikie wrote: "He was not in any sense a trained geologist. He lacked the habit of patient and detailed investigation in departments of the science that did not specially interest him, but which were essential as a basis of accurate induction and successful speculation", though perhaps T. H. Huxley's was a fairer appreciation: "The more I study the fishes of the 'Old Red', the more I am struck with the patience and sagacity manifested in Hugh Miller's researches, and by the natural instinct, which in his case seems to have supplied the place of special knowledge."

It is often assumed that because men like Hugh Miller and Robert Burns were of humble birth and were manual workers that they were without education; but the Scottish parish school system was proof against that. Miller himself said that his want of the more orthodox learning was largely his own fault. "As for Latin," he wrote at thirty-six years of age, "I abominate it, and ever did since I burned my *Rudiments*"; and Latin was a hall-mark. It is recorded that his uncles were prepared to assist him to King's College at Aberdeen, but he became a stonemason against family advice. From his work he contracted silicosis, which ruined his health; and in later years his mind became affected and he shot himself in 1856.

Though Miller wrote much on other geological topics (for example, the shelly boulder-clays of Scotland), it is particularly with the Old Red Sandstone and its fossils that he is associated. He came early under the influence of Dr. John Malcolmson and Prof. Fleming, and later corresponded with Agassiz and with Murchison (who was also a native of the Black Isle). On the other hand he was regarded by many geologists in north-east Scotland as their mouthpiece, and such men as Robert Dick of Thurso kept him informed of their new discoveries and sent him specimens without which much of his work would never have been written.

Miller was born of mixed Scandinavian-Scottish and Celtic stock at Cromarty in 1802, and the cottage in which he was born was handed over to the National Trust for Scotland on September 26, 1938. T. S. W.

News and Views

Dr. C. G. Darwin, F.R.S.

The Lord President of the Council has appointed Dr. C. G. Darwin, master of Christ's College, Cambridge, to the directorship of the National Physical Laboratory, rendered vacant through the ill-health of Prof. R. H. Fowler, who is unable to take up the post. The name of Darwin is so completely identified in popular speech with the author of "The Origin of Species" that it is not always easy to give due credit to the work of his illustrious descendants. Dr. Darwin is a grandson of Charles Darwin, and a son of the late Sir George Howard Darwin, formerly professor of astronomy at Cambridge. He is distinguished for his work in mathematical physics, especially for his researches in collaboration with R. H. Fowler on statistical mechanics (1922) and on the quantum theory of the electron and the atom (1927). He described the electron as a vector wave having two independent components analogous to the polarized components in a wave of light. Much of this later work was done while Darwin occupied the Tait chair of natural philosophy in the University of Edinburgh. There, as a colleague of Prof. E. T. Whittaker, he did much to strengthen the mathematical school in the University, and at the same time his influence was exerted on the council of the Royal Society of Edinburgh. The striking address which he delivered at Cambridge this year as president of Section A (Mathematical and Physical Sciences) of the British Association has been described as a model which other sections might study.

Dr. Alexander Scott, F.R.S.

The announcement of the retirement of Dr. Alexander Scott from the honorary directorship of research at the British Museum Laboratory brings to mind that he was a pioneer in a field of

applied science which, largely through his initiative and vision, has developed beyond all expectations. The idea of having a scientific laboratory in an archæological museum was entirely novel, when, in 1919, the trustees of the British Museum sent a request to the Advisory Council for Scientific and Industrial Research for assistance in connexion with problems of cleaning, restoring and preserving antiquities. That Dr. Scott was called in to advise was singularly fortunate. His wide knowledge of chemistry coupled with his interest in antiquities fitted him peculiarly for the work. Within seven years the original inquiry had been satisfied and the results published in three reports which aroused widespread interest. Early experiences were of incalculable value when he visited Luxor and co-operated with Dr. Howard Carter in preserving many valuable objects from the tomb of Tut-ankh-Amun. As experience accumulated, the fact emerged that scientific assistance could be of much greater value to archæology and the British Museum in general than had been at first supposed. There were questions of authenticity, of the composition of materials, of ancient technique, of classification, and of general diagnosis that could be answered only with the help of qualified scientific staff having the necessary facilities. Dr. Scott has had the satisfaction of founding and controlling the development of a research laboratory which from small beginnings became at length (in 1931) incorporated as a department of the British Museum, and is recognized to-day as being of the first importance by archæologists and museums the world over.

Rejoinder of an Egg Collector

To Mr. Edgar P. Chance all credit is due for his film of cuckoo life, which thrilled every ornithologist who saw it and made a distinct contribution to scientific knowledge. This achievement, however, does not necessarily justify all his other activities, and for his egg-collecting he has been severely criticized. His rejoinder appears as an eight-page pamphlet entitled "An Egg-Collector Replies to his Critics" (Sept. 1938). In our view, an appropriate reply would be to show that the amount of disturbance caused to wild birds was justified by the amount and value of the scientific knowledge gained from the collections and published for the information of other scientific workers. Unfortunately, this reply makes no attempt at such justification, and is marred by expressions which cannot further the case of the egg-collector. The author's ethics are hinted at in a paragraph which states that "Bird Protection laws are proverbially stupid [we have not heard any proverb on the subject] . . . When a law is not worthy of respect it ceases to be law to those who know better". That is a position which cannot be defended, any more than can be the allegation that the bird protection laws are framed "by those who do not understand their subject". Clearly, however, the collector is himself convinced that his collection, which "is complete and only the abnormal can now find a place there", has been brought together without any unwonted disturbance of the numbers or distribution of wild birds.

Accessions to the British Museum (Bloomsbury)

AMONG the accessions to the British Museum (Bloomsbury) reported at the meeting of the trustees on October 8 (the first meeting to be held after the recess) were a number of antiquities from Central America, part of the collection made by the late Mr. T. W. Gann, and bequeathed by him to the Museum. They were accepted by the trustees in May last, but this selection has been received at the Museum only recently. The more important specimens are a number of carved jades, including figures of men and animals, coming mostly from Copan in Honduras. The best example is a magnificent green jade plaque with figures carved in relief. It is said to be the finest known example of carved jade from Central America. It was found at Teotihuacan in Mexico, but is thought to have come originally from Quiriqua in Honduras. By its style it is assigned to the Old Empire of the Maya, and dates probably from the fifth century A.D. In addition the bequest includes a number of fantastically shaped flints of unusual size. Some of these range up to seventeen inches long. There are also a number of painted stucco heads, with elaborate headdresses and some beautiful examples of the Mayan painted pottery. Another accession to the American collections obtained by purchase is an archæological collection from Esmeraldas Province, Ecuador, while an anonymous loan consists of a notable series of antiquities from mexico, which includes a remarkable series of funerary urns in human shape from Oaxaca. The Museum has now received its share of the antiquities found by Sir Leonard Woolley and Mr. M. E. L. Mallowan on their respective expeditions in Northern Syria, which were conducted under the auspices of the Museum jointly with the School of Archæology in Iraq. Grants have been allocated for the renewal of both these expeditions in 1938–39.

Excavations in Northern Syria

MR. M. E. L. MALLOWAN'S expedition to the Habur region of Northern Syria in the spring of 1938, from which came the finds to which reference is made above, excavated four areas, which in conjunction yielded evidence covering a period extending from 3100 B.C. down to 1500 B.C. The remains latest in date were Hurrian houses of mud-brick in three successive levels, ranging in date from 1800 B.C. to 1500 B.C. These yielded a quantity of pottery of white design on black. Some private houses, Mesopotamian in plan, were contemporary with the third dynasty of Ur; but the most important evidence was obtained from the Sargonid level with its Akkadian palace, and the ziggurat, or tower, of Jemdet Nasr date, of which the remains were found beneath the Palace. The Palace, of which a complete ground plan was recovered, is a huge building, 90 metres by 90 metres, ranged about a great court-yard. It was built, as is shown by an inscription, by Naram Sin, son of Sargon, about 2500 B.C. It was destroyed by fire approximately at the end of the Sargonid period and rebuilt under the third dynasty of Ur. Below the south-west corner of the Palace were the ruins of a great tower, which was built

about 3100 B.C. Its dimensions were about 60 metres by 60 metres, and its walls still stand about 10 metres high. It rests on a clay platform, and was found to be packed with votive offerings, among which were about 40,000 beads in a variety of material, though mostly of faience. There were also a large number of amulets, which are beautiful specimens of animal carving and not all paralleled at Ur and Uruk. A collection of alabaster idols consisted of about 200 complete figures, with some thousands of fragments.

Excursion of the Geological Society of France

A. R. LILLIE writes: The *réunion extraordinaire* of the Société Géologique de France was held this year on September 10–17 in the southern French Alps. There was an attendance of ninety-four members, who came from the following countries: France, Belgium, Britain, Czechoslovakia, India, Poland, Spain and Switzerland. The excursion, under the guidance of Profs. Gignoux, Lory, Moret, Raguin and Schneegans, was well organized and was a useful introduction to a territory of fascinating tectonic problems. The party met at Grenoble, where M. Gignoux outlined the objects of the meeting, and then went by motor-car to the Dévoluy. M. Lory there demonstrated the considerable extent of the pre-Senonian folding which he has elucidated during many years work. From Gap as centre, during the following three days, the excursion was conducted in localities situated in the ultra-Dauphinois zone and the sub-Briançonnais zone at Ancelle and in the Ubaye valley. The recent work done in this region, particularly that of Schneegans in the massif of the Grand Morgon, is very impressive in view of the complicated tectonics and the mountainous nature of the ground. Moving on to Briançon for the last three days of the excursion, the party had the opportunity of seeing something of the tectonics in the Briançonnais zone. The final day was spent at the col du Galibier, where all the tectonic elements are to be seen continued northwards into Savoie. An excellent memoire with numerous plates had been prepared by MM. Gignoux and Moret in collaboration with Lory and Schneegans, and a copy was presented to each participant. This memoire, entitled "Description Géologique du Bassin Supérieur de la Durance", appears to include much hitherto unpublished work, and should prove a valuable summary for geologists interested in Alpine tectonics.

The Mellon Institute

THE annual report of the Director of the Mellon Institute for the year March 1, 1937, to March 1, 1938, refers to the interest aroused in hydroxyethylapocupreine, a contribution of the Institute's department of research in pure chemistry. Semi-plant scale operations have been undertaken to provide material for more extensive clinical trials, and other new drugs prepared in the Institute have received clinical trials in cases of pneumonia and pneumococcic empyema. Research on alkyl, hydroxyalkyl and other derivatives of apocupreine is being actively pursued with the object of finding more efficient antipneumococcic drugs. Studies in the treatment of streptococcal and pneumococcal infections have been continued, and research on the variability of the tubercle bacillus has reached a point where it appears to be of some importance in diagnosing anomalous aspects of lung tuberculosis in the benign stages, an advance which may make it possible to use preventive and hygienic measures in time to stop development into the classical and more fatal forms. Seventy-two applied science programmes or fellowships were in operation in 1937–38, new fellowships on amines, anthracite industries, chemical hygiene, cotton, dielectrics, proteins and tar properties commencing operation in the year. Valuable contributions to the improvement of industrial health have been made by the attention given to the medical, engineering and legal aspects of the problems involved. A multiple fellowship on commodity standards has a programme directed to establishing standards for nearly 300 items of staple merchandise so as to provide known values for the consumer. The Cotton Research Foundation is investigating the chemical and physical properties and uses of the whole cotton plant. A new blue print paper has been developed, and a new resin, "Raolin," is also under development. A multiple fellowship on organic synthesis has been concerned with the preparation, properties and uses of a wide range of amines, solvents, intermediates and resins, including various alkylene alkylol and heterocyclic amines, propylene glycol derivatives, silicon and titanium esters of higher alcohols and vinyl resins for protective coatings.

Industrial Development in 1937

A SURVEY of Industrial Development for 1937 recently issued by the Board of Trade includes particulars of factories opened, extended and closed in 1937 with some figures for 1936, and indicates the extent to which industrial development in the form of new factories and factory extensions took place in Great Britain in 1937, together with the areas in which it occurred and the nature of the trades contributing to such development (H.M. Stationery Offices. 9*d*. net). The survey is limited to factories where 25 or more persons are to be or have been employed, and Government establishments set up in pursuance of the rearmament programme are excluded. The Survey shows that 541 new factories, employing 46,700 people, were established in 1937, as against 542 in 1936, employing 49,500 people. The number of factory extensions, however, increased from 185 to 237 and the number of factories closed decreased from 394 to 361. 94 of the new factories represent transfers from other areas and 66 of these are in Greater London. An attempt was made to ascertain the reasons for the location of the new factories. Convenience of premises was the reason given in 212 of the 416 cases for which particulars were obtained, suitability of labour coming next (67), proximity to other factories in the same industry (41), proximity to markets (34), cheap land, low rent or low rates (34), accessibility of raw materials (26), being the other reasons assigned in the relative order indicated.

Greenkeeping Research

THE report of the Board of Greenkeeping Research for 1937 (from the Board's Research Station, St. Ives, Bingley, Yorks. 2*s*. July 1938) shows an increasing amount of advisory work and original investigation at the St. Ives Research Station and at other centres. The Station lives within its income, but research work cannot be greatly extended with the present financial arrangements, as advisory work makes the first claim upon revenue. More advisory work was, moreover, accomplished in 1937 than in any previous year. The volume of research papers does not appear to reflect this policy, however, and a general account of work in progress will be found in the report, and also in a paper by the Station's director, Mr. R. B. Dawson (*J. Roy. Hort. Soc.*, **63**, 8; August 1938). A promising line of investigation concerns the use of potassium permanganate on lawns, to destroy moss and expel earthworms; further developments will be awaited with interest. Supplies of seed of St. Ives creeping red fescue, the first of a series of improved strains of lawn grasses, are now available to greenkeepers. This strain has greater leafiness and density of growth than the existing varieties; it has good winter colour, and reasonable resistance to fungal disease. Successful courses of instruction in the science and practice of greenkeeping have been prosecuted at the Station, and practical demonstration has been greatly improved by the establishment of a permanent exhibition of implements for the treatment of lawns.

Timber Resources of the World

THE small handbook entitled "The Rationalization and Conservation of the Timber Resources of the World" (The Technical Press, Ltd., London. 2*s*. 6*d*. net), by Dr. A. Harold Unwin, is written mainly with reference to the amelioration of the 'Special Areas' and general improvement of woodlands. Dr. Unwin puts forward a series of proposals and suggestions of a somewhat varying nature. In the short period since the Great War, a number of organizations have come into being in connexion with forestry and timber utilization in Great Britain and the Empire. To mention but three, the Forestry Commission, the Forest Products Research Laboratory at Princes Risborough and the Imperial Forestry Institute at Oxford. The timber trade has also a considerable organization. Dr. Unwin wishes for a more rational care of trees and woodlands, especially in Great Britain, and for a better and organized utilization of the world's timber resources. Until recently, Dr. Unwin was conservator and head of the Forest Service in Cyprus, having previously served in Nigeria. Although there is much in the handbook of interest, the same cannot be said of the practicability of some of the proposals. The list of trees given at the end requires considerable revision, and would have been more serviceable had it included the botanical names.

Racial Studies in Italy

IT is announced in the *Corriere della Sera* of October 5 that racial doctrine is to be made part of the curriculum of Italian universities. It is to be taught to students of natural science, medicine, and biology, as well as to students of philosophy, educational theory, and literature. This innovation is made under a decree of the Minister of Education, Signor Bottai. A second course is to be devoted to study of the demographic problem. Italy has been slow in following Germany in the adoption of racial doctrine, nor, as was shown by the report of the Italian men of science on the racial question, has the doctrine been adopted entirely in the form, nor with the enthusiasm, which it has aroused in the country of its origin. The physical characters of the main element in the Italian population would naturally call for some modification, and account for the stress, which in Italy is laid on continuity of cultural history.

Preservation of the Fauna of the Empire

THE Society for the Preservation of the Fauna of the Empire has been accused (according to an editorial note, in the August number of its *Journal*) of talking and doing nothing, while game throughout the Empire is being ruthlessly destroyed. The accusation is unjust. The powers of a private society are in any event strictly limited, since game preservation lies with the official Government of the territory in question. Nevertheless, the Society has investigated conditions in various parts of the Empire, and has reported upon the steps which might usefully be taken for the safety of threatened members of the fauna, always keeping in mind that it is no part of its aim to preserve animal life to the detriment of human industry or the natural development of mankind. The Society does encourage talk about animal preservation, but surely one of the secrets of the success of any great cause is the efficient propaganda which spreads information and may eventually make the cause part of the nation's will.

Agricultural Education in Jamaica

A PAMPHLET of 86 pages (*Bulletin* No. 14, New Series; 1938) issued by the Department of Science and Agriculture of Jamaica indicates the thoroughness with which that Government Department organizes agricultural education in the Colony. It summarizes the series of addresses, lectures and demonstrations given by experts during a special refresher course devised for the staff of instructors of the Jamaica Agricultural Society, and held throughout a week in January. The course was a varied one dealing with aspects of farming which included insects of economic importance to stock maintenance, sugar production, tobacco growing, afforestation, exporting and marketing of produce, banking in relation to agriculture and other subjects. The pamphlet shows that these aspects were treated with thoroughness from the Jamaican point of view, and the appreciation with which the course was received was indicated by an audience of as many as 150 at some of the sessions.

(*Continued on p.* 713)

NATURE

SUPPLEMENT

Vol. 142 SATURDAY, OCTOBER 15, 1938 No. 3598

BRITISH ASSOCIATION DISCUSSIONS

Soil Fertility and Agricultural Policy

SPEAKERS in the discussion in Section M (Agriculture) following the presidential address to the Section at Cambridge agreed that agriculture in Great Britain is declining and the land suffering. The only possible approach to a stable and long-term agricultural policy must be a national one, directed not merely to the production of commodities but also to the maintenance and enhancement of soil fertility.

In his presidential address on "Ley-Farming and a Long-term Agricultural Policy", Prof. R. G. Stapledon stressed the need for maintaining a large and contented rural population with the greatest possible acreage of fertile and ploughable land, managed so as to allow the utmost flexibility of production. The vital need of Great Britain for an abundant supply of fresh food is threatened not merely by war danger but also by the effects of soil erosion and soil depletion in the countries on which we have come to rely for cheap food. The possibility of producing sufficient amounts of fresh food ourselves is not compatible with our present superabundance of permanent grass. We need a survey on the land to map the main types of farming and the facilities of individual farms in order to determine both our potential food production and the way our schemes for subsidizing commodities and planning marketing are affecting the fertility of the land.

Prof. Stapledon gave the following outline classification of farming systems: (*a*) arable farming, including a one-year ley for hay and for maintaining soil fertility, (*b*) alternate husbandry or ley-farming, with arable cropping alternating with leys of either two or three or four to eight years' duration, (*c*) nondescript farming, in which the arable land and the grassland occupy separate parts of the farm, and (*d*) permanent grass. He criticized the last system on both general and technical grounds. Even the poorest permanent grass retains some earning capacity, but it does so at the cost of a low standard of management, complete dependence on imported foodstuffs and great wastage of both manurial residues and potential fertility. Again, as a later speaker said, "Permanent pastures perpetuate parasites".

The best grassland holds within itself an immense store of fertility which can be cashed only by ploughing and cropping and thereby preparing the land for still better grass. The urgent need for lime, which has been emphasized by increased milk production and by the slaughter of young animals, can best be met by applying the lime when the land is under the plough. On the poorest soils there is nothing to equal continued ploughing down of sod, accompanied by lime and phosphate, to build up fertility. Prof. Stapledon particularly recommended the use of contrasted types of ley in rotations—one- or two-years' ley for hay and

deep-rooting residues, and four- to six-years' ley for grazing, leaving shallow-rooting residues rich in clover. Experimental work is needed to discover the best rotations for individual districts and especially to find means of establishing leys without undue risk on the heaviest soils and in the driest regions. These problems and many others in agriculture are more likely to be solved by agronomical investigations than by scientific research. Facilities for conducting field experiments should be enormously increased.

The only solution for our derelict areas is to determine by a survey which fields must be ploughed up and then to devise means of supplying working capital and ensuring its correct expenditure. From his experience in North Wales, Prof. Stapledon favours the idea of loans with a working plan through a 'master borrower' with the necessary tractor and other equipment, or through scheduling districts for a rehabilitation loan on an agreed plan. He believes, too, that the advantages of a more balanced specialization would be secured by a system of 'share farming' by which, for example, a mechanized wheat grower and a poultry farmer might operate over a number of neighbouring ley-farms devoted mainly to milk.

Dr. W. G. Ogg stressed the necessity for checking the drift of poor arable land through inferior pasture to rough grazings and wastes which would ultimately require very difficult and costly reclamation. He doubted whether private individuals, even with cheap long-term credits, could undertake the reconditioning, and suggested that it would have to be done by the State or by some State-aided corporation, working in much the same way as the Forestry Commission does on land which the private owner is unable to afforest. When the land has been reconditioned, and buildings, fences and water supplies made satisfactory, the farms could be rented with a clause in the lease to require suitable manuring and cultivation. Dr. Ogg showed by films some of the work of the Macaulay Institute for Soil Research in the reclamation of peat in Lewis and in Lanarkshire. Satisfactory hay, pasture and silage have been secured by installing long wooden box drains leading to open collecting ditches and by using a rotary cultivator drawn by a caterpillar tractor, and supplying a cheap source of lime and the necessary fertilizers. The spongy fibrous peat from *Sphagnum* in the Lanarkshire experiment has proved more amenable to treatment than the slimy *Scirpus* peat of Lewis, though in the drier parts of Lewis pasture has been established without cultivation and with very little drainage by using fertilizer, grass seeds and clover cleanings. The Lanarkshire experiment was undertaken for the Commissioner for Special Areas in Scotland, and it was estimated that full reclamation would cost about £20 per acre.

In analysing the basis of soil fertility and crop rotation, Dr. E. M. Crowther emphasized the importance of soil structure and plant cover. The essential contrast is between periods of cultivation with rapid oxidation, leaching and degradation of structure, and restorative periods under a vegetational cover leading to granulation of the soil, the return of nutrients to the surface and the production of active colloidal organic matter. Under extreme conditions it has generally been found necessary to restrict, either by prohibition or by compensation, the amount of grazing or the proportion of the land occupied by the most wasteful crops, notably the widely spaced row crops with frequent cultivations. Under our more temperate conditions, there is a need, especially at college farms, for long-range experiments along the lines of recent Rothamsted and Woburn experiments on crop rotations, testing the restorative value of leys, lucerne and green manures and the residual value of straw used directly and in farmyard manure and composts. The use of fertilizers could be made far more efficient by combining a co-ordinated series of field experiments with soil surveys and soil analyses. Such series of experiments are carried out annually in their thousands in most of the other countries of northern Europe, whilst soil analyses have been used by the million in mapping for advisory purposes.

Introducing the discussion on the papers, Sir Daniel Hall said that extra livestock cannot compensate for decreasing crop production, since they are merely the manufactured products of imported foodstuffs. Remedial measures costing some £40,000,000 annually were intended to maintain the *status quo* of our farming, but are not succeeding. Better farming needs a measure of control through the landowner and cannot come through financial stimulus alone. The landowners of Great Britain are so hampered by legislation and the immediate returns are so problematical that the landowners have ceased to have much influence on the farming of their land. Even though land nationalization may not become a matter of practical politics for decades, he suggested that a body should be set up and subsidized by the State to purchase the second-class and poorer land, and get it into order and farmed properly. Such a form of State activity is as necessary to-day as the production of shells and aeroplanes for defence. The State is constantly acquiring large quantities of land for these and similar purposes and "it should also busy itself similarly for the purposes of peace and for improving its own personal estate. If not, what is the alternative ?"

E. M. CROWTHER.

Ecology and Afforestation

THE symposium at Cambridge on "The Cultivation of British Hardwoods" (Department of Forestry, K*) and the papers on "The Ecological Aspects of Afforestation" (Section K (Botany) and Department of Forestry, K*) brought out clearly one point of great practical and scientific importance. It is the need for distinguishing between woodland and non-woodland environments.

Since it is the policy of the Government to add to the existing area of woodlands, it follows that most of the new planting is carried out on soils which bear a kind of vegetation other than woodland, and it is just on this class of soil and under the conditions associated with it that difficulties are experienced in the establishment of hardwoods. Many, if not all, the soils of Great Britain presumably once carried some kind of woodland, but the land has been cleared and put to various uses or misuses. Most of it has been farmed and still is, but at various times some of it has been allowed to run wild. This marginal land is commonly heavy clay or light sand, and its abandonment is usually attributed to falling prices of major farm produce. Doubtless this is a main cause; but it may well be questioned whether modern farming methods, by destroying the physical and biological regime of the woodland soil, have not been a potent contributory cause. Besides the farm land carved from the original forest, there are the wide open spaces of heather, peat or poor grassland to which the forest failed to return because of regeneration difficulties due in the main to grazing, burning, or the lack of parent trees. Under these conditions, too, the forest soil has been altered: in fact the set of conditions associated with a complex biological unit and built up slowly by Nature has been destroyed, or degraded from its woodland status.

The problem stated affords an excellent illustration how the larger light emanating from the study of plant communities in general can be usefully focused upon the practical problems of the forester. For to the ecologist the forest is not merely a collection of trees with a certain density and rate of growth: it is also a community of organisms living together in a more or less intimate and intricate relationship. This forest biological unit is achieved only after much preparation in Nature during the sequence of changes separating the early stages of the plant succession from the later, culminating generally, in the climate of Great Britain, in woodland. It thus becomes easier to understand why trees like oak and beech, which normally appear late in the succession, are difficult to establish on new ground, for the conditions of microclimate and soil (including microflora and microfauna) under which they become established in Nature are widely different from those offered by marginal and waste land. Further, it is well for the forester to realize that in planting he is not only planting to produce timber but he is also setting in train a whole series of processes culminating in the formation of a complex biological unit.

Conifers are less exacting than hardwoods and can be more readily established on land available for planting, and Prof. H. M. Steven in his paper on "The Ecological Aspects of Afforestation in Hill Country" touched on their use as pioneer crops. He said that although vegetation may be a safe guide in the selection of species which will readily become established, it need not necessarily be correlated with the subsequent growth of the trees after they have formed canopy. Here, one can assume that the forest, so to speak, takes charge and changes the environment, so that the coniferous crops now being established may be looked on as catch crops ameliorating the conditions for more exacting species to follow. The same points emerged in Mr. R. Ross's account of the colonization by hawthorn of abandoned arable land in the heavy chalky boulder clay district of west Cambridgeshire: under the hawthorn scrub the soil changes in the direction of a woodland soil in acquiring more humus and an open crumb structure.

A pioneer coniferous crop mostly of pines has been successfully established by the Forestry Commission in Breckland, an area with climate transitional between oceanic and continental and much subject to spring frosts, with open permeable soils incapable of holding much water against shortage during drought and with a chalk content which varies from soils with much, through soils deficient in it, to those completely devoid of it. The last type is extremely infertile. Dr. A. S. Watt gave a summary of his work on the area and concluded that liability to frost, shortage of water and plant nutrients are the critical factors capable of amelioration, at least in part, through normal sylvicultural procedure. By controlling the canopy the internal climate of the woodland is ameliorated and the less hardy species can be successfully reared; by careful choice of species and by planting them in suitable proportions, the water-holding and base-holding capacities of the

soil can be appreciably altered through the control of the amount and, more important still, the kind of humus produced.

In the subsequent discussion, Sir Roy Robinson explained that the exigencies of the moment had largely determined the selection of conifers for planting, and that it was likely that the next generation of the forest would, in certain parts of Great Britain, at least differ markedly in composition particularly by the use of more hardwoods. This is welcome news; and more followed. For Sir Roy announced on behalf of the Forestry Commission the initiation of a programme of closer co-operation between the forester and the scientific worker, particularly the ecologist, and offered to set aside quite considerable areas in selected forests for purposes of scientific study, primarily for a periodic record of the changes in the vegetation. But many scientific interests are involved, and one may look for results fruitful to science generally as well as to the forester, from this opportunity to study a forest in the making.

Limestones as Eruptive Rocks

THE carbonate-rocks, especially limestones and dolomites, are so well known as sedimentary or metamorphosed sedimentary rocks that there may be some surprise that petrologists of Section C (Geology) of the British Association spent the greater part of a day during the recent Cambridge meeting in discussing the origin of carbonate-rocks associated with alkali-rich intrusions.

The occurrence of limestones in close association with alkali-rich rocks, such as nepheline-syenites, phonolites and related types, has been observed with great frequency and it has commonly been assumed that the limestones, where not clearly belonging to a sedimentary formation, were relics of sedimentary limestones assimilated in depth by the igneous magmas.

According to a widely accepted theory proposed by R. A. Daly in 1910, such assimilation of limestone by sub-alkaline magmas is the cause of the formation of the alkali-rich igneous rocks.

However, so early as 1892, some limestones occurring in the form of dykes and cutting the volcanic rocks of the Kaiserstuhl in Baden, were described by A. Knop, and three years later A. G. Hogböm described limestone dykes in a region of alkali-rich intrusives on the island of Alnö in Sweden. Hogböm also recorded calcite as a primary mineral in some rocks at Alnö, and there were other descriptions of primary calcite in alkali-eruptive rocks from Canada and India. In view of the readiness with which calcite dissociates on heating, geologists were reluctant to accept it as a primary mineral or to believe in limestone intrusions, but during the last few years much fresh evidence of apparently intrusive carbonate-rocks has been obtained.

The most convincing new evidence comes again from Alnö, where the rocks are now far better exposed than they were at the time of Hogböm's visits forty-three years ago. They have been studied thoroughly by Dr. Harry von Eckermann, of Stockholm, who opened the discussion at Cambridge. A large area of alkali-intrusives—nepheline-syenites and ijolites—cuts the Pre-cambrian gneisses and is probably late-Jotnian in age. Around the contact with the gneiss (which is altered) crystalline limestones appear, and outside the neck of intrusive rocks there are calcitic and dolomitic dykes which are shown to be cone-sheets dipping towards two deep central foci. From the inclination of the cone-sheets the focus of the calcite dykes can be shown to be at 1–2 km. below the present surface, and that for the dolomitic sheets at 6–7 km. The geology of the country near Alnö is well known, and von Eckermann regards it as certain that for hundreds of miles around and to great depths there is no trace of sedimentary limestone in the Archæan rocks of earlier age than the alkali-intrusives. All the evidence points to a magmatic origin for these limestones at Alnö.

Magmatic origin is also claimed by Dr. F. Dixey for the crystalline limestone associated with breccias filling remarkable vents of post-Karroo age in Southern Nyasaland. At one of the largest of these vents, Chilwa Island, limestone and orthoclase-breccias occupy a roughly circular area 1½ miles across and form steep cliffs rising 1,400 ft. above the level of Chilwa Lake. Nine larger and seven smaller vents are known, and at most of them the limestones are cut by small bodies or dykes of alkali-rich rocks, nepheline-syenite, ijolite, phonolite, or nephelinite. The rocks surrounding the vents are altered and there are many resemblances with the rocks of Alnö. As for the source of the limestone, Dr. Dixey finds that the small lenticles of limestone known to occur in the Basement Complex of the district are altogether too small and infrequent to have supplied the limestone for the great masses of the Chilwa vents, and the conclusion that they are in some way magmatic seems unavoidable.

Mr. S. I. Tomkeieff had visited Fen in Norway, where the rocks, closely comparable with those at Alnö, were described in a classic paper by W. C. Brögger in 1921. He has no doubt about the magmatic origin of the carbonate rocks in that district.

Prof. S. J. Shand claimed that the limestones at Alnö and Fen, and at eight other localities which he listed, had been or ultimately would be proved to be derived from sedimentary or metamorphosed sedimentary limestones. He described two areas of alkali-rich rocks—Haliburton, Ontario, and Sekukuniland, Transvaal—where he regards it as demonstrable that carbonate-rocks associated with nepheline-syenite have been derived by the incorporation of sedimentary or metamorphic limestones by igneous magma.

Prof. C. E. Tilley admitted that the limestone-syntexis theory is applicable in certain places to a limited extent and he believes that the limestone 'intrusions' in the Haliburton and Bancroft areas present certain peculiarities differentiating them from the other occurrences, but he claimed magmatic origin for every other example of limestone associated with alkali-rich rocks in Prof. Shand's list. He mentioned especially Magnet Cove, Arkansas, and Palabora, Transvaal, and he added two new examples: Iron Hill, Colorado, and Kabossero at the head of the White Sea.

The claim for magmatic origin of some of these limestones seems to rest on good field evidence, but it needs to be supported by a credible explanation of how magmatic limestones can be formed and why they are associated with alkali-rich intrusions. To this task Dr. von Eckermann devoted the last half of his address. He outlined the possible processes which might have effected the formation at the base of the Jotnian sheet-intrusions of a nepheline-syenite magma rich in potash, carbon dioxide, fluorine and chlorine, and he traced the possible history of such a magma as it stoped its way upwards to a point at which the concentrated volatiles shattered the roof and more or less pure carbonates filled the conical fractures in the surrounding rock. Mr. Tomkeieff also was able to suggest a possible petrogenetic scheme for the rocks of Fen. He regards carbon dioxide as probably originally present in many rock magmas but lost by most during consolidation. Where it is retained, it must have a profound effect on the course of differentiation. While Dr. Eckermann made no claim that the explanation he had put forward applied outside Fennoscandia, Mr. Campbell Smith, referring to the rocks of the Chilwa Series of Southern Nyasaland, said that there are so many resemblances between them and the rocks at Alnö and Fen that processes which were active in Fennoscandia in the Archæan must have been operative at the Chilwa vents in post-Karroo times. He said that in Nyasaland the problem is to explain the close connexion between the formation of pure orthoclase-rocks (remarkably rich in potash), their brecciation, the alteration of the country rocks, the supply of material for and the emplacement of the crystalline limestone, and the subsequent intrusion of alkali-rich rocks.

When the results of Dr. von Eckermann's work are published, it may be found that all these closely related events will find their places in the scheme of differentiation of which during the discussion he gave a brief description, but which lack of space here compels us to omit.

Vibration in Engineering

FOR the past few years, the council of the British Association, in co-operation with the various sections, has selected a number of scientific topics which are of direct interest to the general public, and by means of symposia or otherwise, to which workers in the particular fields concerned have contributed, general reviews of our present knowledge and the problems still to be solved have been arranged. Among the subjects chosen for the Cambridge meeting was vibration, a phenomenon which, in this mechanical age, is in daily evidence to every one of us, and the importance of which is very great. The engineer is concerned with its results upon the structure in which it occurs, which, in an aeroplane, for example, may be disastrous, and in any event will have a deteriorating effect. The ordinary person, be he traveller in motor-car, train, ship or aeroplane, is more concerned with the discomfort (and even, maybe, injury to health), which accompanies continuous vibration. From whichever point of view it is regarded, therefore, vibration is a phenomenon which everyone desires to see eliminated or reduced to a minimum.

Any elastic structure, when disturbed from rest and released, will vibrate freely for some time in one of a number of possible modes, the particular one resulting depending upon the restraints imposed on the structure and upon the method of disturbance. The frequencies of these modes are called the 'natural' frequencies of the system. When a bridge or ship, for example, is subjected to a

sudden load, it will vibrate in one of these natural modes, but the vibration will be rapidly damped out. When a periodic disturbing force is applied to such a structure, vibration will ensue of the same frequency as the disturbing force, the amplitude depending upon the magnitude of the force. This type is termed 'forced' vibration. When the frequency of the disturbing force is equal to that of one of the natural modes of vibration of the structure, a state of resonance occurs, and, theoretically, for a completely undamped structure, the amplitude will become infinite. Actually, the movement is restricted by the damping of the supports and in the material, and by the fact that the restraints alter completely when the amplitude becomes large; but nevertheless, very serious vibration may and does result in all types of engineering structures under such resonant conditions.

In any motor-car, ship, aeroplane, or other self-propelled vehicle, there are several sources in the machinery from which periodic disturbing forces may arise, and therefore very few such structures are free from forced vibration of one form or another. In order that the amplitude of this should be so small as to be unimportant to passengers, the engineer must do everything possible to balance the machinery so that the magnitude of the out-of-balance forces may be small. If this cannot be achieved by such means, a vibration damper may be used. Such a device was described and shown in action at Cambridge by Prof. C. E. Inglis in introducing the symposium on the subject in Section G (Engineering). It consists of a small spring-supported mass, of about one per cent of the weight of the structure, and attached to it, and tuned to vibrate at the same frequency. Under such conditions it is capable of reducing the vibration of the main structure to very small amounts indeed. Similar devices have been developed for eliminating torsional vibrations in engine shafts.

The most serious cases of vibration, whether considered from a structural or a comfort point of view, are those in which resonance occurs. Under such conditions even a very small residual disturbing force may cause large amplitudes of vibration, and in a completed structure suffering from this type it is usually necessary to alter the frequency of the disturbing force and so destroy the resonance. This, however, cannot always be done without sacrifices in other directions. As Dr. F. H. Todd pointed out, when dealing with ship vibration, if the revolutions of the main engines have to be reduced by ten per cent to avoid resonance with a natural frequency of the hull, this entails, if no other changes are made, a loss of speed of ship of the same order. To recover this loss, a new set of propellers will be necessary, and it is not then always a practical solution, since in certain types of engines, particularly oil engines, it is not permissible to increase the pressures in the cylinders in order to develop the original power at the lower revolutions. One cannot usually destroy resonance in a ship by going to higher revolutions, since within the possibilities of a completed engine the margin will be small, and as soon as bad weather is encountered the revolutions will fall into the resonant range again.

It is evident that the possibility of such resonant vibration should be considered in the early stages of any design in order that the frequencies of the engine forces should not coincide with any of the natural frequencies. Fortunately, as Prof. Inglis pointed out, vibration is one phenomenon in engineering which can be dealt with by precise mathematical methods, and we can calculate the natural frequencies of many designs while they still exist only on paper, and so ensure an absence of resonant vibration in the completed structure. Such calculations can be made for a ship, for example, taking into account the variation in load and strength along the length of the hull girder. A very important consideration in such a calculation appears to be the inclusion of the effect of the surrounding water. This influences the vibration by its damping effect, which will restrain the amplitude at resonance, and also by the virtual inertia effect due to the loss of energy entailed by the movement imparted to the water underneath and alongside the hull as it vibrates. The amount of this virtual inertia can be determined mathematically, and is equivalent to an addition to the hull weight of about its own magnitude for normal ships, and for a wide, shallow-draft ship the increase of inertia may be three times the vessel's displacement. These quantities seem large at first sight, but Dr. Todd showed that the calculated frequencies so obtained for the primary vertical vibration agree remarkably well with the recorded natural frequencies for some sixteen vessels on which he has obtained their values experimentally.

In aircraft, similar vibration troubles arise in the fuselage and air-screws. In many cases these are due to forces originating in the engines, and as before special attention to the balancing and care in avoiding resonant speeds is essential. In addition, vibration can be caused by aerodynamic forces. Examples of such cases were given by Major B. C. Carter, including tail flutter, wing flutter and flutter of air-screw blades. In certain conditions of flutter, instability may arise, and portions of the structure be torn away. Knowledge on this branch has increased greatly of recent years, and enough is now known about it to avoid such disastrous effects. Any new design

of air-screw is also subject to exhaustive tests to ensure that it is free from flutter before being used in machines.

In order to study vibration of aircraft in flight, very delicate instruments are necessary, and some of those developed at the Royal Aircraft Establishment were described by Major Carter. One vibrograph designed there records the amplitude on a photographic film, and can be operated by the pilot during flight by remote control, and yet is very compact and only weighs a little more than two pounds. To obtain records of air-screw blade tip vibration in flight, a camera is secured to and rotated with the hub, the motion of the blade tip being recorded on a film by means of the relative movement of a small electric light bulb cemented to the tip of the blade. Other modern methods include the use of photo-electric cells, the variation of the resistance of a body under stress and cathode-ray oscillographs. It is evident that all the latest developments of the electrical and physical sciences are being adopted in these instruments.

One aspect of the vibration problem touched upon by all three speakers at the symposium was the use of elastic mountings for prime movers, and this is a device which is being developed very rapidly, particularly in the design of motor vehicles. Such mountings bring with them their own problems, but we can look forward to a progressive improvement in comfort in all forms of transport by the successful elimination of vibration through their use. Much remains to be done in this way, but it was evident from this discussion at Cambridge that the engineering profession is fully alive to the necessity and is progressing rapidly in all its many and varied branches.

Incremental Permeability of Special Steels

THE importance now attached to the incremental permeability of silicon-steel and of nickel-iron alloys arises from the use of these materials for the cores of transformers and chokes in communication apparatus. Under these conditions, the magnetization is due to a continuous steady current upon which a variation is imposed either by modulation or by separate coils carrying alternating currents. Generally, the amplitude of the imposed wave is not great enough to reduce the steady magneto-motive force to zero, so that the value of the induction rises and falls as the resultant magneto-motive force changes; but it does not reverse. The calculation of the induced electromagnetic force in a secondary coil in these circumstances is fraught with peculiar difficulties.

Adopting the usual convention and indicating magnetic induction by B, magnetic force by H and permeability, B/H, by μ, then if the mean value of B is not high and its variation small, the mean ratio B/H over the change will approach the value of μ as measured and used for simple alternating currents. But as the mean value about which B varies gets nearer to the saturation region of the iron, and particularly when the imposed variation is large, not only does the mean value of μ fall rapidly, but also its instantaneous value varies considerably. The consequences are (1) that the prediction of a secondary induced E.M.F. is difficult; (2) that if the imposed variation of H be sinusoidal, the wave form of B will be distorted; (3) that if the imposed variation of B be sinusoidal, the wave form of H will be distorted; (4) that losses associated with given variations in B and H become difficult to measure and very different from those in the same iron under simple alternating current conditions. Yet makers of communication apparatus must know what results they may expect from the material that they purchase, so that some method of specifying and of testing the quality of steel for these purposes is badly needed.

This was pointed out by Dr. L. G. A. Sims at a meeting of Section G (Engineering) of the British Association at Norwich (1935), and he added that the British Standards Institution specification for transformer steels (No. 601), which had been published that year, would not serve for these new purposes. Section G, recognizing the importance of the matter, asked Dr. Sims to ascertain what was being done, both in England and abroad, and to report at the Blackpool meeting in the following year. As a result, a questionnaire containing eleven questions was sent out from the University of Birmingham, and an analysis of the replies was presented at the British Association meeting of 1936, representatives of the British Standards Institution being present. On seven of the questions, world opinion was sufficiently unanimous to enable Section G to ask that tests should be begun upon silicon steels based upon an alternating current method of test, sinusoidal variation of induction at 50 cycles per second and with samples in the form of a ring.

In February, 1937, the British Standards Institution formed a committee to consider the drafting of a specification based upon these tests and the extension of such tests to cover the much

wider conditions occurring in practice. The experimental work has been proceeding at both the University of Birmingham and the Northampton Institute, Clerkenwell, London, and substantial progress has been made by the British Standards Institution Committee. At the Nottingham meeting of the British Association (1937), when papers embodying the results to date were read, it became evident that methods of defining and measuring the harmonic content of a distorted wave were needed, and that there were difficulties in connexion with symbols. Two methods of measuring the wave distortion were given, and the experiments by Greig and Parton proved that this factor could be determined either by a filter-bridge or by an alternating current potentiometer.

The papers presented at the Cambridge meeting of the British Association, before a joint meeting of Section A (Mathematics and Physics) and Section G, showed a great extension of the experimental work by the teams in Birmingham and London; and in addition, Mr. D. C. Gall gave an account of the manner in which academic instruments could be adapted to commercial requirements; while Mr. C. E. Webb outlined the rapid advances that are being made in alloys suitable for transformers and communication apparatus.

The subsequent discussion was remarkable for the comments by makers and users of the steels under test; it is a pity that more time could not be allotted for valuable contributions of this kind which the British Association, and perhaps the British Association alone, can evoke. In the matter of symbols and definitions, little progress was made, the only helpful remarks coming from Prof. G. W. O. Howe, who showed that, in Germany, both definitions of 'distortion factor' suggested by Sims and Greig were used rather indiscriminately with little inconvenience. The official view of the British Standards Institution was expressed by Mr. J. F. Stanley. He emphasized the role of that Institution as a body holding a balance between research and utility, and therefore bound to search for a practical specification. He remarked upon the fact that the research work in this instance was unique in that it is in the hands of educational institutions and not commercial research organizations. He welcomed as a guide the broad discussion at the British Association, but held that actual decisions must be left to the Institution Committee. Many references were made to the new materials mentioned by Mr. Webb. More than one speaker commented upon the amazingly high permeabilities which he had disclosed. On the other hand, doubt was expressed as to whether such values would be found under polarized conditions, for Parton and Glazier have shown that there is an actual reversal of the usual order of permeability of annealed and unannealed specimens when they are polarized. Again, in connexion with the effect of impurities in alloys, one speaker (Mr. W. Randall) said that atomic order has been found very important, especially in the case of molybdenum and of chromium, and that the direction of the crystal axes also must not be overlooked. Others warned the investigators that results obtained on silicon steel would not apply to nickel iron alloys; and, as Mr. Ronald Sankey reminded the meeting, the new cold-rolled silicon steels may call for special attention.

Two general suggestions of great value emerged from the steel makers and users who were present. The first, stressed by Mr. Ronald Sankey and Mr. K. Macfadyen, was to the effect that tests suitable for quality control and acceptance—routine tests in fact—should be kept separate from tests devised to determine the exact properties of the materials. This, of course, is bound up with the question of apparatus suitable for routine work; in which connexion, as an addition to Mr. Gall's proposals, both the disk magnetometer and the 'Ferrometer' were mentioned. It is one thing to deal with a few ounces in the laboratory; quite another to deal with tests on 50 tons of stampings, and no doubt the industrialists were right to direct attention to this question of perspective. Dr. E. H. Rayner, of the National Physical Laboratory, thinks that it might be advantageous to put forward a 'temporary specification' that could be tried and revised after a year or so.

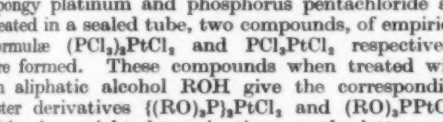
The other suggestion was a plea that any specification should so far as possible be international. Section G has from the first kept this in mind, as is shown by the wide dissemination of the Birmingham questionnaire; but the duty of seeing that British steel-makers are not penalized in the world's markets is a new aspect of this question which the British Standards Institution must not neglect.

The discussion very properly laid bare the great difficulties, both academic and practical, with which this subject bristles. It is clear that progress is being made, and nothing but good can result from such an open and free debate. At the same time, the whole development shows a section of the Association moving in a new and useful direction. For, not content with recording the advancement of its science for the benefit of the public, it has pointed out to an industry a region in which scientific advance is needed. Further, with the friendly co-operation of that industry, it has initiated a movement which will help manufacturers to specify and to test the magnetic qualities of their most important raw material.

Organic Chemistry of the Metals

A DISCUSSION on recent advances in the organic chemistry of the metals, which had special reference to the transitional metals, was held in Section B (Chemistry) during the Cambridge meeting of the British Association. It was opened by Dr. F. G. Mann, who said that recent advances in the organic chemistry of the metals are so numerous and cover so wide a field that any attempt to deal comprehensively with them in the brief time available would become a mere catalogue of individual investigations. The most important advance, which in his opinion was the investigations (mainly by Hans Fischer and his co-workers) into the structure and synthesis of the porphyrins, was, however, too specialized and too complicated for suitable treatment on that occasion; he therefore limited his own contribution to an account of certain polynuclear metallic compounds, since this work was largely carried out in Cambridge, and its discussion, which followed logically from Prof. C. S. Gibson's presidential address to Section B, involved certain questions of chemical linkage which are of fundamental and therefore general interest.

It has been known for many years that when spongy platinum and phosphorus pentachloride are heated in a sealed tube, two compounds, of empirical formulæ $(PCl_3)_2PtCl_2$ and PCl_3PtCl_2 respectively, are formed. These compounds when treated with an aliphatic alcohol ROH give the corresponding ester derivatives $\{(RO)_3P\}_2PtCl_2$ and $(RO)_3PPtCl_2$. Molecular weight determinations on the latter compound show, however, that it has the molecular formula $[(RO)_3PPtCl_2]_2$, and Werner suggested in 1909 that the parent compound had the structure (I) or (II). Similar results have been obtained with the corresponding palladium derivatives.



(I) (II)

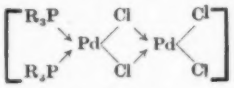
Decisive evidence for this 'bridged' linkage of metallic atoms through acid radicals has, however, only recently been obtained, when its existence in gold compounds was proved by Gibson and Powell (cf. the sectional presidential address) and in palladium compounds by Mann, Purdie and Wells.

The non-ionic derivatives of the tertiary phosphines and arsines with palladium dichloride, of general formulæ $[(R_3P)_2PdCl_2]$ and $[(R_3As)_2PdCl_2]$, were known to have the *trans* uniplanar configuration. Mann and Purdie showed that these compounds in hot alcoholic solution readily react with ammonium palladochloride giving derivatives, for example, $[(R_3P)PdCl_2]_2$, similar to (I) and (II). These 'bimolecular' derivatives should theoretically exist in three

$$[(R_3P)_2PdCl_2] + (NH_4)_2[PdCl_4] = [(R_3P)PdCl_2]_2 + 2NH_4Cl$$

forms, the unsymmetrical form (III) and the *cis* and *trans* symmetrical forms (IV) and (V). In the crystalline state they occur in only one form, which is the same in both the phosphine and arsine series, since the corresponding members in the two series are isomorphous. This form has been shown by Mann and Wells to be the *trans* symmetric form (V).

There is abundant evidence, however, that these compounds in organic solvents give a tautomeric mixture of the three forms (III), (IV) and (V). This is shown partly by their anomalous dipole moments,



(III)

(IV) (V)

which have been measured by Dr. Finn at Oxford, and partly by their chemical reactions. Thus strong evidence in favour of the unsymmetric form (III) is provided by $\alpha\alpha'$-dipyridyl (symbolized by 'dpy'), which splits the phosphine compound thus:

$$[(R_3P)_2PdCl_2PdCl_2] + dpy = [(R_3P)_2PdCl_2] + [dpy\ PdCl_2]$$

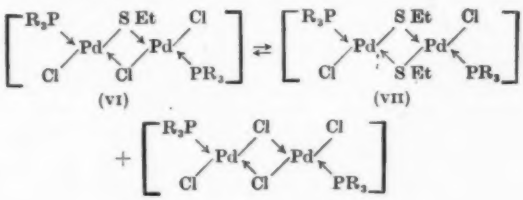
Moreover, the dichloro-oxalate, which presumably has also the unsymmetric structure, gives a similar reaction:

$$[(R_3P)_2PdCl_2PdC_2O_4] + dpy = [(R_3P)_2PdCl_2] + [dpy\ PdC_2O_4]$$

On the other hand, a monacid base such as *p*-toluidine (represented as B) splits the compound in its symmetric form:

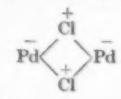
$$[(R_3P)ClPdCl_2PdCl(PR_3)] + 2B = 2[(R_3P)(B)PdCl_2]$$

The formation of this equilibrium from the homogeneous crystalline compound shows that the unbridged groups in these molecules must readily interchange their positions. This mobility is not, however, limited to the unbridged groups. Chatt and Mann recently showed that the trichloro-monomercapto derivative (VI) in organic solvents readily produces an equilibrium with the dichloro-dimercapto derivative (VII) and the tetrachloro-compound (V). Hence the bridging groups also possess considerable mobility.



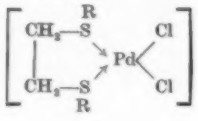
(VI) (VII) (V)

Prof. N. V. Sidgwick had pointed out that the symmetric forms (IV) and (V) differ from the unsymmetric form (III) inasmuch as they possess the ring

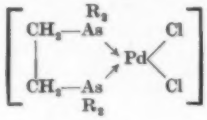


(VIII)

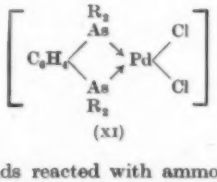
(VIII) and might be expected to have greater stability than the unsymmetric form (III). The chelated di-sulphide and di-arsine compounds (IX), (X) and (XI) have consequently been prepared by Chatt and Mann. If



(IX)

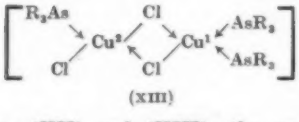


(X)

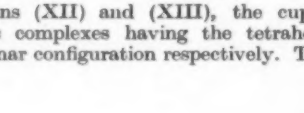


(XI)

these compounds reacted with ammonium palladochloride, the resulting 'bridged' compounds must have the unsymmetric structure of type (III). Actually no 'bridged' derivatives were obtained from these three compounds, and it appears therefore that the unsymmetric compounds are too unstable to exist in the solid state. On the other hand, Mellor, Burrows and Morris prepared two isomeric cuprocupric compounds, of formula $[(R_2As)_3Cu_2Cl_3]$, and suggested that these isomerides have the



(XII)



(XIII)

constitutions (XII) and (XIII), the cuprous and the cupric complexes having the tetrahedral and the uniplanar configuration respectively. The former compound possesses a ring structure electronically similar to that in (III), and decisive evidence for the structure of these isomerides would be of great interest. Reference was also made to the cuprous and argentous compounds $[R_2As{\rightarrow}CuI]_4$ and $[R_2As{\rightarrow}AgI]_4$ investigated by Mann, Wells and Purdie.

Prof. L. O. Brockway pointed out that investigations of the structure of organic derivatives of the noble metals now afford definite information with regard to the number and length of the bonds by which the metallic atom is linked to other groups, as well as the characteristic inter-bond angles; the number of such bonds is 2, 4, 5 or 6 in the compounds of various metals. The 4-covalent metals in the copper and nickel groups have a planar configuration in the divalent state (for example, the above palladium compounds, the cupric and argentic picolinates, and the nickel, palladium and platinum aldoxime derivatives) and a tetrahedral configuration in other valency states (for example, $[Cu(CH_3CSNH_2)_4]Cl$, $Ni(CO)_4$, $(CH_3)_3PtCl$). The 2-covalent metallic complexes have a linear configuration (for example, $[Ag(CN)_2]$), the 5-covalent a trigonal bipyramid (for example, $Fe(CO)_5$) and the 6-covalent an octahedral configuration. He emphasized, however, that the work of Mann and Wells on the bridged palladium compounds shows that the co-ordinate and covalent links (as represented in the above formulæ) are identical in length, and that it is impossible to make a clear distinction between these links in complex metallic compounds. As an example of the variation of bond length with the number of bonds per atom, he cited the series $Ni(CO)_4$, $Co(NO)(CO)_3$, $Fe(NO)_2(CO)_2$, $Cr(CO)_6$. The metallic atoms in these compounds are isoelectronic, but whereas the observed bond-length to carbon in the first three compounds is 1·82–1·84 A., in the fourth compound it is 1·91 A.

A very interesting example of the application of complex metallic compounds to the study of nuclear physics was given in a preliminary announcement by Dr. B. C. Saunders. Dr. Goldhaber and he have used the non-ionic cupric derivative of ethyl aceto-acetate to effect the separation of the active isotope of copper ($^{64}_{29}Cu$). The copper aceto-acetate is irradiated by slow neutrons and its activity measured: it is then dissolved in chloroform and shaken with aqueous copper acetate. Some of the active isotope is thus transferred to the aqueous solution, from which it is precipitated by zinc, and its activity is measured. The chloroform layer gives copper aceto-acetate of much reduced activity. F. G. MANN.

Recent Research in Seismology

UNDER the chairmanship of Dr. C. G. Darwin in the morning, and of Mr. R. S. Whipple in the afternoon of August 23, a symposium on seismology covering a very wide field of topics was held at Cambridge in Section A (Mathematics and Physical Sciences) of the British Association. At the outset, a very warm tribute was paid by Dr. F. J. W. Whipple to the pioneer work of Dr. C. Davison, who was the secretary of the earth tremors committee in 1895, when Prof. John Milne returned to England from Japan. The work of these and others has led on to the present work on the International Seismological Summary, now being carried on by Miss E. F. Bellamy and Mr. J. S. Hughes. There are now 439 observatories in the northern hemisphere and 59 in the southern hemisphere sending seismological readings to Oxford, from which it has been possible to locate 2,865 different epicentres between 1913 and 1935. It is hoped that more stations will be initiated in the southern hemisphere, especially in South America and South Africa.

In pure seismology, the discussion was continued by Miss I. Lehmann of Copenhagen, who described and explained the characteristic seismograms obtained

on instruments at different epicentral distances, the differences being due to reflections and refractions of the various pulses in the interior of the earth. The suggestion by the late Prof. H. H. Turner of the occurrence of especially deep focus earthquakes had been confirmed by the work of Dr. R. Stoneley, Mr. F. J. Scrase and others, and this led Dr. H. Jeffreys to suggest that the hypothesis of Barrell was probably correct when he attributed finite strength to the earth down to a depth of about 700 km. Further, the work of Dr. D. W. Phillips helps to explain the existence of aftershocks, in that it has been shown that rocks may possess several strengths according to the method of application and duration of the forces. The intensive study of deep focus earthquakes is likely to lead to solutions of some difficult seismological problems, including the depth of the core, the nature of the 20° discontinuity, and the times of transmission of the transverse wave up to epicentral distances of about 25°.

In continuation, Dr. R. Stoneley showed that, as the result of considerable labour, Turner's readings of the *L* phase of earthquakes corresponding to 0·48 min./degree could be identified with long Rayleigh waves, and that the readings corresponding to 0·41 min./degree could be assigned to the arrival of long waves first theoretically predicted by Prof. A. E. H. Love. The former are usually designated *LR* waves and the latter *LQ* waves. It is suggested that the difference between these two types of waves is due to differences at the origin. *LQ* and *LR* are well separated at distances greater than 50°.

Of interest to pure seismology is the work of Prof. J. D. Bernal, who concludes that there may be, at the pressures and temperatures existing at some depth within the earth, a denser and less compressible form of olivine, $(MgFe)_2SiO_4$, than occurs normally on the surface. This would possibly explain the 20° discontinuity. Crystallography should also be considered when discussing the structure of the earth's core.

Interesting on account of its application to both pure and applied seismology is the work of Dr. D. W. Phillips, who described experiments he has performed in compression, bending and torsion on coal measure sandstones, siltstones, mudstones, shales and coals, and also on some samples of marble. These experiments show up very clearly the imperfect elasticity of the rocks, which behave as perfectly elastic under stresses applied for a short time, but give 'hysteresis loops', possibly with complete recovery only after a very long time, when a stress is applied for a longer time. An interesting phenomenon found is that a stress large enough to give irrecoverable deformation may at first give only continuous deformation and yet lead to fracture if it is maintained long enough. Dr. Jeffreys showed later how this may account for the occurrence of continuous folding and fracture in the same arch, a common geological phenomenon. The fracture would cause an earthquake.

In the realm of applied seismology, Mr. T. F. Gaskell described the method of working and the results of the work of Dr. Bullard and himself. The method is to fire a small amount of gelignite and record automatically the seismic waves set up, by means of geophones at 200 ft. intervals up to 1,000 ft., recording the initial time of the shock by a radio signal. From the resulting seismograms the shape of the palæozoic floor of part of eastern England has been determined, the process being facilitated by the fact that the wave velocities in the palæozoic rocks are high, whilst those in the chalk and overlying strata are low.

Educational Significance of the Cinema and Wireless

A JOINT discussion at Cambridge on August 23 between Section J (Psychology) and Section L (Educational Science) on the cinema and wireless in education was opened by Mr. R. C. Steele, who dealt mainly with broadcasting.

Pointing out the remarkable growth in the use of broadcast methods since they were first introduced in schools fifteen years ago, especially in the last two years, Mr. Steele referred to the difficulty of evaluating their effects. He suggested that with dull or backward children the broadcast lesson is probably more effective in proportion to their ability than with the brighter pupils. It also offers a change from ordinary routine, presenting new material in a new and vivid way, which appeals to the imagination. He considers that with the backward child it is a further advantage that the broadcaster, though he may ask questions, does not expect answers, and the dull child may thus gain confidence instead of being made conscious of inferiority to others. Mr. Steele stressed the importance of personality and, discussing the use which could be made of broadcasting in education, suggested that where detail is of prime importance, as in a science lesson, the film is likely to be supreme. Where perfection of detail is less important and immediacy is the first consideration, broadcasting and television may give the best results, and he predicted a great future for television in school teaching.

Mr. Steele's paper was supplemented by a paper by Miss L. M. Holt giving some statistical results of tests made with children who had been having wireless and ordinary lessons alternately, which were designed to determine the characteristic contributions of this new aid to teaching. The spontaneous contrasting of the facts in their possession was slightly higher in essays based on wireless lessons than in essays based on oral lessons, while a fine perception of specific or significant detail also characterized the wireless essays, indicating a good grasp of the subject.

Dr. P. B. Ballard, discussing the effect of wireless and the cinema on the life of the school child, emphasized the experimental nature of the educational film as part of the school programme. It cannot be assumed that the child always prefers a talking to a silent film. There is direct evidence to the contrary, and for educational purposes the evidence indicates that the film should be short—for example, five to ten minutes—and unless the commentator speaks slowly and clearly and in simplified language appropriate to the audience, a silent film

with printed captions is preferable. Reference was made to the bad influence of the ordinary cinema on children, particularly through displaying life not as service and quiet happiness but as self-indulgence and the mad pursuit of pleasure. Dr. Ballard was emphatic that ordinary broadcasting should not be allowed to curtail a child's necessary quota of sleep or to interfere with his homework.

Though broadcasting as compared with the educational film is comparatively mature, both methods have certain common characteristics and drawbacks. They are not complete educational units; there is no give and take between teacher and taught. They belong to the passive side of school work rather than the active—the impressional rather than the expressional. Both also have their affinity with mass instruction rather than with individual study. The capital virtue of the film is that it enriches the pupil's experience, while that of the radio talk is that it can do for the teacher what he could not do for himself. Dr. S. J. F. Philpott suggested that both methods may tend to diminish the gap between the dull and the brighter pupils.

The closeness with which a crowded audience followed the discussion bore witness to the deep interest in the possibilities of this new technique, and also to the realization of the dangers which attend its abuse in adult life as well as in childhood and adolescence.

Professionalism in the Modern World

IN a highly suggestive paper on "Professionalism" read before Section F (Economic Science and Statistics) at Cambridge on August 19, Mr. T. H. Marshall reviewed the development of the professions and discussed their place and inference in society to-day. According to Herbert Spencer, the history of the professions can be traced back to primitive societies. From the first they were non-manual, and Mr. Marshall pointed out that their second characteristic was that they were not commercial, an ethical distinction clearly stated by the Greeks. Payment must not be the motive in professional work. The third characteristic of professionalism, the association, follows from the first two. It serves to maintain the power of brain-work to command the produce of manual labour, and it ensures that men, who must not work in order to be paid, are nevertheless paid enough to support them at the right social level. The official aim of a professional association is the preservation of a high standard of efficiency among its members. This is achieved by training and examining all candidates for admission and by obtaining privileges as against all non-members, which may amount to a legal monopoly. Such rights can only be claimed where the profession is based on a body of special knowledge or on a scientific technique which can be imparted in training colleges and tested by examinations. The typical professional association is a body that controls the application of science to the service of society.

In spite of this corporate responsibility to society, the professions are by tradition intensely individualistic, and the close personal relation of trust between the professional man and his client has proved an obstacle to the enlistment of the professions in the service of the State. Under the growth of science, the evolution of capitalism and the advance of democracy towards the social service State, not only have many new professions been developed but also the part played by personal character and tradition in the older professions has diminished. Capitalism requires professional men to work for impersonal corporations and may make him an employee. Democracy is leading the professional men to study the whole social background of the problems confronting him, and the professions are being transformed from strongholds of narrow individualism into most hopeful agencies for scientific social planning.

Simultaneously, Mr. Marshall pointed out, the antithesis between commerce and the professions has been greatly weakened. While the professions have been enlisted in the service of trade, the administration of trade is becoming professionalized. The salaried employees of big businesses are, like the professional man, neither capitalists nor wage-earners. Mr. Marshall suggested that they might become merged into a homogeneous social group, working not for profit, but for economic security, and out of interest in the job, a group favouring rational planning in public life, and individual freedom in private life, a group opposed to war whether between nations or between classes. There is much in common between professionalism in its modern form and some parts of the theory underlying Fascism. Moreover, if this new class is to be effective, either its tactics must be Fabian in the extreme or it must seek allies. Mr. Marshall suggested that the vital question is the attitude this new class is inclined to take up towards the conflict between capital and labour, or whether it is likely to evolve a system of its own differing from that advocated by either of the two contending parties.

PRINTED IN GREAT BRITAIN BY FISHER, KNIGHT AND CO., LTD., ST. ALBANS

Research Co-ordination Committee

AN account of the work carried out by the Research Co-ordination Committee during the past year was given at a meeting of the Group held in Cambridge on August 22. The work included (1) a list of essential statistics, on which the views of bodies utilizing statistical data (Political and Economic Planning, Engineers' Study Group, New Fabian Research Bureau), the Institute of Statistics and several leading statisticians have been obtained; (2) co-ordination of work on South Wales problems including a résumé of industrial proposals, bibliography on South Wales, report on land improvement, and on family budgets of employed and unemployed workers; (3) information on numerous societies and sources of information, which it is hoped will be published in the form of a directory of associations. The Research Co-ordination Committee has also been active in bringing together editors of scientific and other periodicals to consider co-ordinating publications and has gathered material which is to be put before the new Division of the Social Relations of Science of the British Association.

Safeguarding Unpublished Research

DURING the recent period of uncertainty in international relations, the Research Co-ordination Committee approached several organizations having valuable unpublished data with the view of securing co-operation for their safety in case of war. The microfilm technique of duplication was considered, since it is relatively inexpensive (about 0·1*d.* per page) when the necessary apparatus, which can be hired for a minimum period of one year, is available. This could be arranged if a sufficient number of bodies co-operate. The response has been satisfactory, and others interested should communicate with the Hon. Secretary, Research Co-ordination Committee, 35 Gordon Square, London, W.C.1.

Memorandum on Smallpox

DURING the last three years, Great Britain has enjoyed comparative freedom from smallpox, and the Ministry of Health has therefore considered it appropriate to issue a memorandum in order to direct the attention of local authorities to the possibility which now exists of limiting the spread of smallpox by prompt and vigorous action as soon as it is reported to have appeared (Memo. 215 (Med.). London: H.M. Stationery Office. 2*d.*). The memorandum contains an account of the incidence of, and mortality from, smallpox in England and Wales since 1901, and a summary of the procedure which should be adopted should the disease appear in a district.

Suggested Science Museum for Cambridge

A LARGE exhibition of historic scientific instruments and specimens was arranged under the auspices of the Cambridge Philosophical Society for the meeting of the British Association last August. It was most gratifying to see the long series of instruments associated with the great masters of the Cavendish Laboratory—with Wollaston, Clerk Maxwell, J. J. Thomson, Rayleigh and Rutherford—but the older periods were also well illustrated by loans from the colleges. At the final meeting of the General Committee in Cambridge, it was resolved "that an expression of hope that the scheme for a permanent exhibition of historic scientific instruments in Cambridge would be brought to fruition, should be communicated to the University authorities", and this has been done.

Electrified Omnibuses

MR. A. E. WISEMAN, 21 Hanbury Road, Acton, London, W.3, writes stating that on boarding an omnibus recently, he felt a distinct electric shock on grasping the metal handrail, with one foot on the step and the other on the pavement. The effect was also observed by others, particularly on 'crisp' mornings. He suggests that the electricity may be caused by the friction of the tyres on the ground, which incidentally insulate the body of the bus. It is of interest to note that this effect was described in a letter in NATURE of June 29, 1929, p. 981, by Sir Charles Boys, who observed it on a hot dry day and ascribed it to the scuffling of the tyres on the polished asphalt.

A Naked-Eye Sunspot

A GIANT sunspot, easily visible to the naked eye, is crossing the sun's disk in latitude 17° north from October 5 until 18, the time of central meridian passage being October 11·9. The area of this spot on October 6, corrected for foreshortening, was nearly 2,500 millionths of the sun's hemisphere, and on October 8 its area measured 2,800 millionths, the measurements being made at Greenwich Observatory. The spot on the latter date extended in solar longitude for about 125,000 miles. Sunspots as large as this one are usually associated with terrestrial magnetic disturbances commencing about one day after the time of central meridian passage. On October 7, a small magnetic storm was recorded at the Greenwich magnetic observatory at Abinger, the disturbance reaching a maximum between 16^h and 20^h U.T. The ranges of the magnetic elements were: in declination 51′; in horizontal force 200 γ; and in vertical force 260 γ. It seems uncertain, however, whether this magnetic disturbance can be linked to the big sunspot; the most probable time of one related to the disturbed area of the sun containing this sunspot would be about October 12–13.

Colonial Service Appointments

THE following appointments in the Colonial Service have recently been made: W. D. L. Corby, agricultural officer, Nigeria; T. N. Greeves, agricultural officer, Nigeria; D. G. Jones, agricultural officer, Malaya; H. T. Measurs, agricultural officer, Kenya; R. J. S. Waddington, inspector of mines, Nigeria; D. Luke, veterinary officer, Uganda; L. D. Branch, inspector of plants and produce, Gold Coast; C. L. Crosse, sleeping sickness control officer, Nigeria; J. H. C. Hicks, sleeping sickness control officer, Nigeria; R. Patterson, inspector of plants and

produce, Gold Coast; B. E. V. Parham (temporary assistant agricultural officer), agricultural officer, Fiji; J. D. Tallantire (agricultural officer, Nigeria), agricultural officer, Gambia (seconded); H. E. Hornby (director of veterinary services), director of tsetse research, Tanganyika Territory; D. A. Donald (temporary assistant agricultural officer), agricultural officer, Fiji; D. L. Foster (temporary assistant agricultural officer, Jamaica), junior agricultural instructor, British Honduras; L. W. Harwood (temporary assistant agricultural officer), agricultural officer, Fiji.

Biology in Education

UNDER the auspices of the Educational Advisory Board of the British Social Hygiene Council, a conference of principals and biology lecturers in training colleges will be held on October 22 at the British Medical Association House, Tavistock Square, London, W.C.1. Prof. J. B. S. Haldane will speak on "How to Make Biology Alive", and his remarks will be followed by discussion. Dr. Philippa Esdaile will speak on "The Place of Field and Practical Work in the Biology Course". A discussion on "The Concept of Human Biology" will be opened by Mrs. E. J. Hatfield and Dr. H. C. Squires. A selection of biological films will also be exhibited. Further information can be obtained from the Secretary, Educational Advisory Board, British Social Hygiene Council, Tavistock House South, Tavistock Square, London, W.C.1.

Announcements

PROF. B. W. HOLMAN, assistant professor of mining in the Imperial College of Science and Technology, has been awarded the Gold Medal of the National Bureau of Scientific and Industrial Research by the French Minister of Instruction and Fine Arts. The award of this medal to a British subject is very unusual.

DR. ALBERT E. QUINE, a medical officer of the Ministry of Health, has been appointed inspector of anatomy in England and Wales.

SIR HENRY BASHFORD, chief medical officer of the General Post Office, and Sir Kenneth Lee, chairman of Tootal Broadhurst Lee Co., Ltd., have been appointed to fill vacancies in the membership of the Industrial Health Research Board of the Medical Research Council.

THE Council of the Iron and Steel Institute confirms that, in accordance with previous announcements, the joint Autumn Meeting of the Iron and Steel Institute and the Institute of Metals in New York and the tours in Canada and the United States of America have been cancelled. The Autumn Meeting of the Iron and Steel Institute will be held at the Institution of Civil Engineers, Great George Street, Westminster, S.W.1, on October 26, at 10 a.m. and at 2.30 p.m. The Institute of British Foundrymen has accepted an invitation for members to take part in the discussion on the third report of the Steel Castings Research Committee which will be presented during the afternoon session.

THE Council of the Iron and Steel Institute has accepted an offer from Captain C. A. Ablett to present a prize of £50 for the best paper on steelworks engineering submitted to the Institute, written by a junior engineer employed in a British iron or steel works, irrespective of whether or not he is a member of the Institute. Competing papers should be marked "Ablett Prize Paper" and sent to the Secretary of the Iron and Steel Institute, No. 4 Grosvenor Gardens, London, S.W.1, not later than January 31, 1939.

THE fifth biennial conference of the National Council of Mental Hygiene will be held at the Central Hall, Westminster, on January 12–14, 1939. Further information can be obtained from the Secretary of the Council, 76 Chandos Street, Palmer Street, London, S.W.1.

APPLICATIONS are invited for the Eunice Oakes research fellowship at the Hospital for Sick Children, Great Ormond Street, London, W.C.1. Candidates must be less than thirty-five years of age. The salary will not be less than £750 per annum. Further information can be had from the Secretary of the Hospital.

THE Middlemore Prize for 1939 in medical and surgical ophthalmology, consisting of a cheque for £50 and an illuminated certificate, founded in 1880 by the late Mr. Richard Middlemore of Birmingham, is offered by the British Medical Association for the best essay on the underlying causes of glaucoma with suggestions as to future research in clinics and laboratories. The essay should be sent to the Secretary, B.M.A. House, Tavistock Square, London, W.C.1, before December 31, 1938.

THE Council of the Ophthalmological Society of the United Kingdom has established a Treacher Collins prize of £100 to be awarded triennially for the best essay submitted upon a subject selected by the Council. The subject for the first award is "Cerebro-spinal Disease in Relation to the Optic Nerve". Essays should be sent before December 31, 1938, to the Hon. Secretary, Ophthalmological Society of the United Kingdom, 5 Racquet Court, Fleet Street, E.C.4.

IT has been decided to form a medico-historical museum in Berlin after the model of the Wellcome Museum in London.

AN unusually large number of cases of infantile paralysis in Holland this summer has caused German authorities in some districts to forbid Dutch children crossing the frontier.

Letters to the Editor

The Editor does not hold himself responsible for opinions expressed by his correspondents. He cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 721.

CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

Discovery of an Additional *Pithecanthropus* Skull

DURING the systematic search for fossil man in Java, one of us (G. H. R. von K.) discovered, in 1937, in the Trinil formation of Sangiren (Central Java), an almost complete brain case of *Pithecanthropus*[1].

Amongst the material recently collected (July 1938) from the same area, a large fragment of an additional *Pithecanthropus* skull came to light. The fragment consists of the complete right parietal bone with the adjoining part of the left parietal bone and a small piece of the occipital bone. The three bones embrace in their original and entirely undisturbed arrangement a stone core composed of sandy tuff mixed with lapilli. The sagittal suture reaching from bregma to lambda is completely preserved. The right parietal bone also exhibits all the other sutures, only the sphenoidal angle being broken off. The coronal contour of the parietal bones is characterized by a very pronounced sagittal crest. Laterally there is a distinct depression reaching to the temporal line, from which the contour runs steadily outwards down to the squamous suture. The temporal line runs strikingly close to the sagittal suture.

These conditions entirely correspond to those which are characteristic of the Sinanthropus skulls. The pronounced flattening of the cap, so specific for the two *Pithecanthropus* skulls known hitherto, is completely missing in the case of this new *Pithecanthropus* skull. On the other hand, this skull has the following peculiarities in common with both *Sinanthropus* and *Pithecanthropus* skulls: the lowness of the entire cap and the position of the greatest breadth, the latter having undoubtedly been situated above the origin of the zygomatic arch, as is the case with all *Sinanthropus* and *Pithecanthropus* skulls.

According to the state of the sutures, the new skull belongs to a juvenile individual, in spite of the fact that the parietal bones show a thickness of more than 10 mm. near the bregma, and that the temporal line is well developed. The region of the occipital torus is preserved only to a very small extent, revealing only a faint swelling, apparently in correspondence with the age of the individual.

All the new *Pithecanthropus* finds demonstrate how important and promising it is to search for fossil man in Java, and to continue the work which has been made possible thanks to the generous support of the Carnegie Institution of Washington, D.C.

G. H. R. VON KOENIGSWALD.
FRANZ WEIDENREICH.

Bandoeng,
Java.

[1] *Proc. Kon. Akad. van Wetenschappen, Amsterdam*, 1938.

Two Stellar Systems of a New Kind

SOME months ago, an extremely faint, widely-extended stellar system in the constellation Sculptor was reported from the Harvard Observatory[1]. In many respects it appeared to be unlike any known stellar organization. The finding more recently of a similar system in Fornax, on photographs made with the telescopes at the southern station of the Observatory, suggests that a description of these objects may be of general interest.

The two objects are separated in the sky by a little more than 20°, and both are in the south galactic polar cap[2]. The following tabulation, in which some of the quantities are clearly provisional, compares the two systems:

	Sculptor Cluster	Fornax Cluster
Right Ascension	$0^h\ 57{\cdot}8^m$	$2^h\ 37^m$
Declination	$-34°\ 2{\cdot}5'$	$-34°\ 47'$
Galactic latitude	$-83°$	$-64{\cdot}5°$
Angular diameter	80′	60′+
Total magnitude	9·0:	9·5:
Magnitude of brightest stars	17·8	18·0:

The distribution of stars is very similar in the two systems. There are no irregular nebulosities, no clumping of stellar images, no sharp or bright nuclei—only smooth and essentially symmetrical concentration to the centre, with approximately 10,000 stars to magnitude 19·5. In uniformity and radial symmetry they resemble globular star clusters.

The occurrence, within the areas covered by the clusters, of numerous faint external galaxies of the usual types and abundance, shows that space absorption within the clusters is negligible and also permits the close comparison of their members with faint spheroidal galaxies. It is thus determined that these two systems are not supergalaxies (rich groups of galaxies), but are composed of stars.

The distances and linear dimensions could be readily determined if we knew the absolute magnitudes of the brightest stars. Colours and spectra may be procured eventually and assist in evaluating the luminosities, but at present we hope to find the distances through the discovery and measurement of Cepheid variables among the stars of magnitude 19·5 and brighter. Appropriate plates are being taken with the 60-in. reflector at Bloemfontein.

It is probable that the resemblance to globular clusters also holds for the distribution of absolute magnitudes and that the distance modulus, $m-M = 5\ (\log d-1)$, for these two objects is not greater than 19·5. The corresponding distance of eighty kilo-parsecs implies that they are of galactic dimensions and places them well within our local supergalaxy, three times the distance of the Magellanic Clouds and but a third of the distance to the Andromeda

Nebula. At the distance of the Andromeda system these objects would, in fact, have long escaped discovery. There may be several others in the local group of galaxies; such objects may be of frequent occurrence in intergalactic space and of much significance both in the census and the genealogy of sidereal systems.

The new objects have some properties in common with globular clusters, others with spheroidal galaxies, and still others (nearness and complete resolution into stars) with the Magellanic Clouds. If intermediate forms connecting them with one of these standard types were found, a correct interpretation would be facilitated.

Within the large area covered by the Virgo supergalaxy (distance two to three megaparsecs) is a number of seventeenth magnitude objects which are of low surface brightness and about one minute of arc in diameter; they are possibly clusters of the Sculptor-Fornax type, associated in this supersystem with the two hundred or so typical galaxies that have magnitudes from 11·0 to 13·5. Details of the examination of this possibility will be reported elsewhere.

HARLOW SHAPLEY.

Harvard Observatory Station,
Bloemfontein.

[1] *Harvard Obs. Bull.*, 908 (1938).
[2] *Harvard Obs. Circ.*, 423 (1937).

Nature of Extensive Cosmic Ray Showers

THE counter experiments of Auger, Maze and Grivet-Meyer[1], and those of Kolhörster, Matthes and Weber[2], indicate the existence of very large cosmic ray showers, extending over an area of many square metres, and consisting of several thousand particles. In order to obtain information about the constituents of these showers, a cloud chamber with a 2 cm. lead plate across its centre, situated in a room with a light roof, has been used in a magnetic field of 800 gauss. The chamber was controlled by the five-fold coincidences of counters, distributed so that the outer counters were separated by 5 metres. With this counter arrangement the chamber took, on the average, 0·2 photographs per hour.

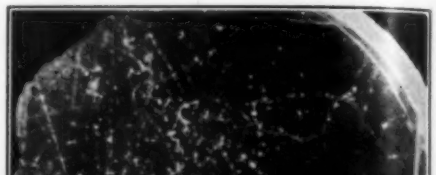
The twenty-two successful photographs obtained show, in all, about 250 incoming tracks, all of which can be interpreted as electron tracks. Some of them produce small showers in a 2-cm. lead plate in the chamber, and there is no indication of the presence of particles other than electrons. One of the photographs obtained is reproduced herewith. This is a part of the large shower which caused the five-fold coincidence in counters separated by 5 m. The photograph shows a typical cascade process; several particles, apparently energetic electrons, enter the lead plate and produce at least seven centres of multiplication.

According to these photographs, it seems very likely that, if penetrating particles are present, they constitute only a small fraction of the shower particles, and are certainly insufficient in number to account for the penetration found by Auger, Maze and Grivet-Meyer. It is thus possible that the large air showers are in fact ordinary cascade showers. A similar conclusion for the narrow air showers has been reached by one of us[3].

The distribution of the numbers of incoming tracks over the individual photographs is as follows:

					Total
No. of photographs	11	9	9	4	33
No. of incoming tracks	0	1	2–10	>10	{250 above the plate {300 below the plate

The average number of tracks per photograph given by the number in the above table is 8. It can easily be shown, however, that in order to calculate the mean density of tracks, this number must be reduced to about 5, because of the selective effect of the counter arrangement. The area of collection for the



CLOUD CHAMBER PHOTOGRAPH OF AN EXTENSIVE COSMIC RAY SHOWER IN A MAGNETIC FIELD OF 800 GAUSS.

chamber can be taken as the area of the lead plate in the chamber, which is 75 sq. cm. The mean density of tracks is then 700 per square metre. This value is about twenty times that estimated by Auger, Maze and Grivet-Meyer[1] from counter observations. The discrepancy, however, can be explained as follows.

A counter discharge takes place regardless of the actual number of particles passing simultaneously through the counter, provided there is at least one. Thus with counter observations it is not possible to differentiate between the passage of one, or more than one particle, incident simultaneously on the counter. Therefore the average number of particles incident on a counter can only be estimated by assuming a certain distribution law. The calculations of Auger, Maze and Grivet-Meyer assume inherently a Poisson distribution, that is, statistical fluctuation of the number of simultaneous tracks per unit area. But since the average number of tracks per photograph is 5, the probability of finding, due to statistical fluctuation, 150 incoming tracks on a single photograph (as has been observed once) is about 10^{-30} and is thus negligible. Hence it may be seen from the data in the table above that the distribution of the numbers of tracks on individual photographs differs widely from a Poisson distribution. The comparatively low density estimated from the counter experiments can then be understood as due to the assumption of only statistical fluctuations.

Auger, Maze, and Grivet-Meyer found that one

eighth of the shower particles penetrate more than 10 cm. of lead. Assuming these particles are electrons, the cascade theory shows that their energy must be greater than 5×10^{10} e.v. If we assume an area of 400 square metres for some of the showers, then according to our new estimate of the mean density of shower particles, some of the showers contain 30,000 particles ($\frac{1}{3} \times 400 \times 700 \doteqdot 35{,}000$) of this energy. The total energy of these particles would amount to nearly 2×10^{15} e.v. and the total energy of the whole shower, taking into account also the particles of lower energy, would be still higher, perhaps as much as 10^{16} electron volts.

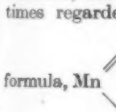
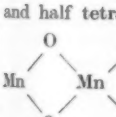
L. JÁNOSSY.
A. C. B. LOVELL.

Physical Laboratories,
University of Manchester.
Sept. 2.

[1] Auger, P., Maze, R., and Grivet-Meyer, T., *C.R. Acad. Sci.*, **206**, 1721 (1938); **207**, 288 (1938).
[2] Kolhörster, W., Matthes, I., and Weber, E., *Naturwiss.*, **26**, 576, 1938.
[3] Jánossy, L., *Proc. Camb. Phil. Soc.*, in the Press.

Magnetic Anisotropies and the Valencies of Paramagnetic Atoms in Crystals

STUDIES on the magnetic anisotropies of paramagnetic crystals are of interest because of the variety of information one can obtain from them under favourable conditions, on such widely different topics as (1) the magnitude and the asymmetry of the internal electric field acting on the paramagnetic ion in the crystal; (2) the geometry of distribution of the negatively charged atoms immediately surrounding the paramagnetic ion, and hence the co-ordination number of the ion; (3) the magnitude of the Stark-separation of the energy levels of the ion in the above field (in the special case when the paramagnetic ion in the crystal is in the S-state, the Stark-separation of its levels is naturally feeble, and it plays an important part in determining the thermal behaviour of the crystal at very low temperatures, in the neighbourhood of 0·1° K.); (4) the strength of coupling between the orbital and the spin angular momenta of the electrons in the incomplete shell of the ion, etc. In some recent papers[1] we have dealt with these various aspects of paramagnetic studies on single crystals. In the present note we wish to direct attention to another useful application, namely, to questions concerning the valency of the paramagnetic atom in the crystal.

We shall take, for example, the well-known crystal manganite, the chemical composition of which corresponds to that of hydrated hemitrioxide of manganese. On the basis of the available chemical evidence, the manganese in the compound is sometimes regarded as trivalent, corresponding to the formula,  , and sometimes as half divalent and half tetravalent, corresponding to the formula,  . A measurement of the magnetic anisotropy of the crystal should enable us to decide readily between these two alternatives. The Mn++ ion is in the S-state (^6S), and should therefore be almost isotropic. The Mn++++ ion, which is in the ^4F-state, and resembles Cr+++, should also have very little anisotropy. On the other hand, the Mn+++ ion, the ground state of which is ^5D, should have a relatively large anisotropy in the asymmetric crystalline field. A measurement of the anisotropy of the crystal, that is, the difference between its maximum and minimum susceptibilities, to find whether it is of the same order of magnitude as in manganous and chromic salts, namely, 10^{-5} per gram atom of manganese at room temperature, or is very much greater, will therefore decide whether the manganese atoms in the crystal are half of them divalent and the other half tetravalent, or all of them trivalent.

The crystal is monoclinic, and at 31° C. its maximum anisotropy, namely, $\chi_c - \chi_a$, is found to be $4{\cdot}0 \times 10^{-6}$ per gram atom of manganese; which shows that the manganese atoms in the crystal cannot be trivalent.

The mean susceptibility of the crystal does not give us similar information. The susceptibility of Mn+++ lies almost midway between those of Mn++ and Mn++++; and further, the exchange interaction between the spin moments of Mn, which should be large in this crystal owing to the large concentration of manganese, affects the mean susceptibility considerably, and to an uncertain extent, whereas its influence on the anisotropy is almost nothing.

K. S. KRISHNAN.
S. BANERJEE.

Indian Association for the
Cultivation of Science,
Calcutta.
Aug. 30.

[1] *Phil. Trans. Roy. Soc.*, 1933–38.

Relativistic Motion of a Radiating Mass

IN 1926, Prof. E. W. Brown[1] raised the question whether the usual equation,

$$m\frac{dv}{dt} = F, \qquad (1)$$

is rigorously true for a radiating star and, in a letter to NATURE, Sir Joseph Larmor has advanced, from considerations of momentum, that (1) is true.

The motion of a radiating star, according to general relativity, does not seem to have been discussed in any of the standard treatises on the subject. Granted that a non-radiating small mass describes *approximately*[2] a geodesic in the space-time field, the question is whether a radiating small mass also does the same just as, in classical mechanics, equation (1) holds good whether a mass radiates or not. To settle this question we may write the equation of conservation of momentum, for the particle and the outgoing radiation, as the former traces its world-line, as:

$$(mv^\mu)_\nu v^\nu + \lambda v^\mu = 0, \qquad (2)$$

in the usual tensor notation. Hence

$$v_\mu(mv^\mu)_\nu v^\nu + \lambda v_\mu v^\mu = 0,$$

and, as $v_\mu v^\mu = 1$, it follows that

$$\frac{dm}{ds} + \lambda = 0; \qquad (3)$$

substituting for λ in (2)

$$(mv^\mu)_\nu v^\nu - \frac{dm}{ds}v^\mu = 0,$$

or

$$m\left(\frac{d^2\eta^\mu}{ds^2} + \Gamma^\mu_{\alpha\beta}v^\alpha v^\beta\right) = 0. \qquad (4)$$

It is clear, therefore, that a radiating small mass will also trace a geodesic.

Another point[3] arises here which is of considerable theoretical interest. For a non-radiating mass, equation (3) gives a constant m, and the equation of conservation of momentum (2) thus splits up into the two

$$\text{(i)}\quad \frac{dm}{ds} = 0, \qquad \text{(ii)}\quad m(v^\mu)_\nu v^\nu = 0 \qquad (5)$$

The corresponding classical equation of conservation of momentum does not imply the constancy of inertial mass as in (5i), and Mach had to supplement, therefore, the Newtonian laws by his theory of the inertial mass determined by the ponderable bodies of the universe.

V. V. NARLIKAR.

Benares Hindu University.
Sept. 6.

[1] Larmor, Sir Joseph, "Coll. Papers", **2**, 672 (1929), or NATURE, **117**, 300 (Feb. 27, 1926). See also "Astronomy and Cosmogony" by Sir James Jeans, 298 (1929).
[2] Narlikar, V. V., NATURE, **141**, 906 (May 21, 1938).
[3] Eddington, Sir A. S., "The Mathematical Theory of Relativity", 127 (1924). The interpretation of (5) is not, however, mentioned in Eddington's book.

Infra-Red Absorption Spectrum of Sulphur Trioxide

THE infra-red absorption spectrum of gaseous and liquid sulphur trioxide has been determined by us, in the laboratory for physical research at the Sorbonne, in the region extending from 7μ to 14μ, with the help of the self-registering rock salt infra-red absorption spectrometer developed and described by Lambert and Lecomte[1].

In the final experiments, the absorption of the vapour at ordinary temperature was measured in an atmosphere of air in a tube of about 10 cm. length—closed at both ends by plates of rock salt—forming part of an all-glass apparatus possessing a reservoir filled with liquid sulphur trioxide, separated from the absorption tube by a glass wall which was broken immediately before the beginning of the measurements. The apparatus was filled at Amsterdam by the technique developed by Smits. Owing to a small quantity of water vapour present in the air, some 'fog' was sometimes formed, but in such a small concentration that it did not give any trouble. It is of great importance, but not easy, to avoid this formation of 'fog', which causes a rapid attack on the plates of rock salt. Some preliminary experiments on the absorption of concentrated sulphuric acid in a layer of some microns thickness, between plates of fluorite, have shown that its absorption is very weak.

For the vapour two infra-red absorption bands were found, at 8·9 μ and at 7·5 μ, with the latter the stronger, corresponding with frequencies of about 1120 and 1330 cm.$^{-1}$. The Raman spectrum of gaseous sulphur trioxide shows with certainty only a frequency-shift of 1069 cm.$^{-1}$, while from experiments with the liquid at different temperatures and mixed with sulphur dioxide, the vibrational frequencies 531, 1068 and 1389 (double, in reality 1379 and 1404) for the simple molecule in the *liquid* may be inferred[2].

The complete absence of the intensive Raman shift 1068 in the infra-red absorption in the vapour proves that the *free* molecule of SO_3 has a plane, practically symmetrical configuration[3]. For such a molecule the symmetrical pulsatory vibration is not combined with a change in the electric moment of the molecule, so that in infra-red absorption it is inactive.

The number of fundamental modes of vibration of such a molecule amounts to four, probably corresponding with frequencies of about 530 and 560 (symmetrical and anti-symmetrical deformation vibration respectively)—the latter inferred from the absorption band at 1120 cm.$^{-1}$, supposing it to be a first harmonic—and further, 1069 and 1330. (Owing to the much larger mass of the sulphur atom in SO_3, compared with the central atoms in the related groups CO_3'' and NO_3', the frequency of the vibration (560), whereby the central atom moves fairly strongly perpendicular to the plane of the O-atoms, may be expected to be considerably smaller for SO_3, than for the groups mentioned, where 870, 835 respectively have been found.)

For the liquid, several absorption bands corresponding with frequencies (in cm.$^{-1}$) of about 795 (12·6 μ); 860 (11·6 μ); 940 (10·6 μ, weak); 1065 (9·4 μ, strong); 1205 (8·3 μ, moderately strong); 1330 (7·5 μ, moderately strong) have been found, without doubt belonging to different kinds of molecules present in this partially polymerized liquid[2]. The strong appearance of the frequency 1065 in absorption in the *liquid* proves that in this state the single molecule SO_3 is considerably deformed from the plane symmetrical configuration it possesses in the vapour state.

No sign of absorption in the neighbourhood of 1390 cm.$^{-1}$ (7·2 μ) has been found in the vapour or in the liquid.

It is a curious fact that the absorption bands at 12·6 μ and 11·6 μ are in their intensity dependent on the circumstances of the experiments. For example, in a mixture of sulphur trioxide with about the same volume of carbon disulphide, the intensity of the band at 12·6 μ diminishes considerably, while that of the other increases.

Our hearty thanks are due to Prof. A. Cotton for his hospitality and to Prof. A. Smits for permission to construct the apparatus at Amsterdam.

H. GERDING.

Laboratory of Physical and Inorganic Chemistry, Amsterdam.

J. LECOMTE.

Laboratoire de Recherches Physiques à la Sorbonne, Paris.
Aug. 29.

[1] Lambert, P., et Lecomte, J., *C.R.*, **189**, 155 (1929).
[2] Gerding, H., Nijveld, W. J., and Muller, G. J., NATURE, **137**, 1033 (1936); *Z. phys. Chem.*, B, **35**, 193 ff. (1937).
[3] Compare also "Die Theorie der Komplexität und der Allotropie" 262 (1938).

CH Bands in the Night Sky Spectrum

So long ago as 1934, we observed, in the night sky spectrum, radiations characteristic of the nuclei of the comets, at about λλ 4300 and 4050 A.[1]. Their origin was then unknown. The recent identification[2] of cometary radiations near λ 4300 with a band of the CH molecule induced us to search systematically for the CH bands in the sky spectrum. For this purpose we used unpublished tables of wave-lengths measured by Gauzit in the ultra-violet and by Cabannes and Dufay in the blue and violet regions of the visible spectrum.

Band λ 4300. The dispersion of the spectrograph

is too small to allow us to find in the sky spectrum all the details observed by Dufay in cometary spectra. Nevertheless, the correspondence between the sky radiations and the first rotational lines of each branch of the band is satisfactory. We find in the sky the $R(3)$, $R(2)$ and $R(1)$ lines at λλ 4291, 4295 and 4299–4303; a stronger emission at λ 4312·5 can be identified with the two Q branches; we find $P(3)$ and $P(4)$ at about λ 4330, $P(5)$ at λ 4338.

When we observe the spectrum of the sky near the horizon, the strong Vegard-Kaplan band of nitrogen at 4316, degraded towards the red, hides the last two CH lines; but, at the zenith, while the whole Vegard-Kaplan system weakens, these lines become very visible; therefore there is something more in this spectral region than a Vegard-Kaplan band.

Since the intensity of the CH band does not obviously vary from the zenith to the horizon, it is not impossible that the CH molecules are outside the atmosphere and that a part of the night sky luminescence has an interplanetary or an interstellar origin. It is interesting to recall that Swings has already proposed to identify the λ 4300 interstellar line, observed as an absorption line in stellar spectra, with the $R(1)$ line of interstellar CH molecules[3].

Group of lines near λ 4050. These radiations of cometary nuclei occur also in the sky. Cabannes and Dufay have shown that the lines of the 4050 and 4300 groups correspond to each other with a constant difference of frequency[4], which is about 1500 cm.$^{-1}$. In agreement with Baldet's observations, we cannot therefore identify the 4050 band of cometary nuclei and of the night sky with the weak Raffety band which, according to Grenat[5], is similar to the 3900 band. It is possible that the group at λ 4050 represents a new CH band similar to the 4300 band.

Band λ 3900. The 3800–3900 region is one of the least known in the spectrum of the sky. Flint prisms are not transparent enough, while quartz prisms do not give sufficient dispersion. On the other hand, the 3889 Vegard-Kaplan band coincides with the Q branches of CH. The P branch only appears distinctly, the $P(2)$ lines at λ 3897 and the $P(3)$ lines at λ 3902.

Band λ 3143. The very prominent maximum of this band is found in the sky at λ 3144. We have observed also the weaker maximum at λ 3157. No other origin has been suggested for these two sky radiations.

Hence we conclude that the known CH bands probably exist in the spectrum of the night sky. The radiations near λ 4050 form perhaps a new band similar to the 4300 band and certainly distinct from the Raffety band. The emission occurs at a very high altitude or even outside the atmosphere. We intend to compare again the intensities at the zenith and near the horizon in order to decide whether the emission of the bands that we attribute for the present to CH molecules is or is not connected with the earth's atmosphere.

J. CABANNES.
J. DUFAY.
J. GAUZIT.

Université de Paris
and Observatoire de Lyon.
Aug. 25.

[1] Cabannes and Dufay, *Comptes rendus*, **198**, 306 (1934); 68e *Congrès des Sociétés Savantes*, 66 (1935).
[2] Nicolet, M., *Z. Astrophys.*, **15**, 154 (1938); Dufay, J., *Comptes rendus*, **206**, 1550 (1938).
[3] Swings, P., and Rosenfeld, L., *Astrophys. J.*, **86**, 486 (1937).
[4] Cabannes et Dufay, *Comptes rendus*, **203**, 903 (1936).
[5] Grenat, H., *Comptes rendus*, **192**, 1553 (1931).

Fatty Acids from Yeast as Respiratory Factors

A NUMBER of papers[1] from this laboratory have reported the preparation from yeast and malt-combings of fractions which stimulate the respiration of yeast and of animal tissues, particularly of skin. A study of these fractions appears to indicate the existence of a multiplicity of respiratory factors. The fractions studied thus far have been water-soluble and thermostable. They have all contained nitrogen and phosphorus, but the fractions have been manifestly impure and it has been difficult to correlate the respiratory activity with chemical properties except to indicate that protein probably plays no part. On the other hand, it has been possible to correlate the proliferation-promoting activity of preparations from yeast with nucleic acid-like materials containing guanine, adenine, phosphorus and pentoses, and having a maximum in ultra-violet absorption[2] at 2600 A.

We have now found that the steam-distillation of a crude concentrate prepared by extracting yeast with aqueous alcohol yields about 0·05 per cent (based on the yeast) of a light coloured water-insoluble substance having an indefinite melting point near room temperature and an unpleasant odour suggestive of isovaleric acid. It does not contain nitrogen or phosphorus. It is soluble in alcohol, ether, benzene, and alkali. It has an iodine number of 5·5 by the Hanus method. The high neutralization equivalent of about 295 is probably accounted for by the presence of contaminating fat-soluble materials. From the steam distillate can be obtained a nearly colourless potassium salt which is unmelted at 300° C. but darkens at 210° and dissolves in water to form an alkaline solution. The material gives a negative Liebermann-Burchard reaction. These properties point to a mixture containing saturated fatty acids.

The material causes as much as a 350 per cent increase in oxygen uptake of a yeast suspension in concentrations of 0·5 mgm. per c.c., but higher concentrations are less effective and 10 mgm. per c.c. is inhibitory. In nearly all concentrations, the material is markedly inhibitory to the respiration of rat skin, although in low concentrations (1 mgm. per c.c.) a slight stimulation is observed. This behaviour is duplicated qualitatively by pure saturated fatty acids such as capric and undecanoic. Thus, the respiratory activity of the distillate appears to be related to its fatty acid content.

The steam distillate, in proper concentrations, markedly stimulates the growth of epithelium in tissue cultures. In the concentrations thus far investigated, the material appears to be inhibitory to yeast growth and fermentation.

A detailed account of this work will appear later.

ELTON S. COOK.
CORNELIUS W. KREKE.

Institutum Divi Thomæ,
Institute of Scientific Research,
Cincinnati, Ohio.
Aug. 30.

[1] Fardon, Norris, Loofbourow and Ruddy, NATURE, **139**, 589 (1937). Norris and Kreke, *Studies Inst. Divi Thomæ*, **1**, 137 (1937). Cook, Hart and Joly, *Proc. Soc. Exptl. Biol. Med.*, **38**, 169 (1938). Cook, Kreke, and Nutini, *Studies Inst. Divi Thomæ*, in the Press. Cook and Kreke, *ibid.*, in the Press.
[2] Cook, Loofbourow, and Stimson, 10th International Congress of Chemistry, Rome, May, 1938. Loofbourow, Cook, and Stimson, in the Press.

Blood Ammonia and the Deaminases of Adenosine and Adenylic Acid

THE characteristic value of the general blood ammonia in man was shown to be either zero or below the analytical level[1]. This has been confirmed for the rabbit and by H. Kropowski for the dog, using the technique of this laboratory[2].

After shedding, the ammonia develops from three sources. The first or alpha ammonia (about 40 γ ammonia $N/100$ ml.) forms immediately after shedding whether the *p*H of the blood be maintained or not, but does not form in the presence of carbon dioxide. The amino compound involved may be adenosine protected by carbon dioxide (though the complex formation does not appear to be readily reversible) and deriving in turn from one or other of the adenylic acids. Plasma has been shown to deaminate adenosine with great specificity, leaving unattacked more than fifty other substances of biological significance and with amino or volatile amine groups. This plasma deamination of adenosine and its great specificity was shown by one of us[3] prior to the communication of Drury *et al.* to the Physiological Society in January 1937.

The second or beta formation (about 1 mgm. $N/100$ ml. in the rabbit) comes from adenylpyrophosphate in the red corpuscles, breaking down mainly through the following stages: adenylpyrophosphate → adenyldiphosphate + 1 phosphate → adenosine + 2 phosphate → inosine + 3 phosphate + ammonia. (The phasic formation of ammonia previously reported[4] appears to be associated with the re-esterification of adenylic acid.) Adenylpyrophosphate disappears practically quantitatively in rabbit blood with the appearance of free ammonia. The chief reason for supposing the final stages is that muscle adenylic acid in *high* concentration is freely deaminated by laked red corpuscles and vegetable adenylic acid also, but only at a small fraction of this rate. As the concentrations of the acids are diminished so also is the deamination rate, but to a lesser degree for vegetable adenylic acid. At a concentration of 0·05 per cent of the nucleotide they are deaminated at about the same rate. This can be interpreted satisfactorily only on the basis of an initial dephosphation—at the low concentrations—followed by a deamination of the formed adenosine.

The third or gamma ammonia (about 100—200 γ $N/100$ ml. for man, and a mean of about 350 γ $N/100$ ml. for the rabbit, judging from the twenty-four hours formation) appears to derive largely if not entirely from vegetable adenylic acid, this being first dephosphated and then deaminated. The following evidence exists for this supposition.

(1) Vegetable adenylic acid is deaminated at the required rate, muscle adenylic acid and adenylpyrophosphate being excluded by the fact that the action of striped muscle extract has no effect in raising the plasma ammonia.

(2) The rate of the gamma ammonia formation in plasma plotted against the *p*H shows two peaks, one in the region of 6·8 and the other at about 8·6. This double peak is characteristic of a phosphatase action signifying a preliminary dephosphation. When vegetable adenylic acid is added to plasma, the extra ammonia formed after 24 hours shows a similar double peak and in the same position.

(3) A large number of other possibilities has been excluded; for example, guanylic acid, guanosine, cytydylic, cytidine, etc., but not the adenyl compounds of desoxyribose, which remain as possible but unlikely precursors.

Concerning the adenylic acid and adenosine deaminases of blood and tissues, it may be noted that adenylic acid in laked blood (and five other tissues similarly examined) is deaminated in proportion to its concentration beyond a certain critical value of 0·1–0·2 per cent of the nucleotide. The activity of the deaminase also per unit volume of blood increases markedly with the dilution. On the other hand, the ferment in striped muscle (about forty times greater in the mean than that of any other tissue) acts independently of the substrate concentration. The indication is that the ferment in the red corpuscle and other tissues—except voluntary muscle—is reversibly bound to some inhibiting substance, which may be described as a protector substance for adenylic acid. Comparative values of the adenosine and adenylic acid deaminases (adenylic acid in 1 per cent concentration) were studied in thirty-six tissues of the rabbit. With regard to the adenosine deaminase, it is a curious fact that the *appendix showed the highest concentration in the body*, having a mean value of 55·6 units of enzyme concentration (the unit being γ $N/$ minute/gm. tissue) compared with about 6–8 for whole blood, ileum and cæcum. The values for duodenum and jejunum were also high but not so high as the appendix. Of the eleven types of glandular tissue studied, it is noteworthy that the liver came second lowest with 3·7 units (it contained the lowest amount of adenylic deaminase, namely, 2·2 units). The muscle group contained the least amounts of adenosine deaminase, the muscle of the auricle being highest in the series with 6·8 units and voluntary muscle lowest with 0·9. The content in adenylic acid deaminase followed to some extent that for adenosine, with many marked differences, the most extreme being voluntary muscle, which contained in the average about 1,000 enzyme units. This enzyme also is greatly in excess of the adenosine deaminase in conducting nerve, cerebral cortex and pituitary gland; and in the alimentary distribution we have the proportion reversed. No pure adenylic acid deaminase was found in plasma.

The above research was supported by a grant from the Irish Medical Research Council.

EDWARD J. CONWAY.
ROBERT COOKE.

Department of Physiology and Biochemistry,
University College,
Dublin.
Sept. 3.

[1] Conway, E. J., *Biochem. J.*, **29**, 2755 (1935).
[2] Private communication from the Warsaw laboratory.
[3] Thesis to U.C.D. on ammonia formation in blood and tissues (1936).
[4] Conway, E. J., and Cooke, R., NATURE, **139**, 627 (1937).

Application of the Feulgen Method to the Study of Viruses

'NUCLEOID' bodies giving a positive Feulgen reaction have been shown to be integral constituents of various kinds of spore-bearing bacilli[1] and also of *Bact. Coli* and "*Bact. paratyphosum*"[2]. Photographed in ultra-violet light, these bodies proved to possess the specific absorption characteristic of nucleic acid.

So far as we are aware, Haagen is the only investigator who has applied this reaction to a virus. He has stated[3] that the inclusion bodies of vaccinia give

a positive Feulgen reaction, but that the elementary bodies are negative. We have been able to confirm Haagen's findings so far as concerns the elementary bodies and the small inclusions which characterize the early stages of infection, but we have invariably obtained a negative result with the large irregular type of inclusion present during the later hours.

The Feulgen-negative inclusion bodies of vaccinia and the elementary bodies stain red with Giemsa's stain. The small Feulgen-positive inclusions stain deep reddish purple, while bacteria stain a deep bluish purple. Both the elementary bodies and the large forms of psittacosis virus stain a purple rather than a red colour with Giemsa's stain. This circumstance induced us to test the various developmental stages of this virus with the Feulgen technique. Positive results were obtained both with free elementary bodies in smears made from the spleens of mice which had died of the disease, and with all the various intracellular stages found in tissue cultures infected with the virus.

Through the kindness of Dr. G. M. Findlay, we have also been able to examine smears of lymphogranuloma inguinale virus. As Findlay, Mackenzie and MacCallum have shown[4], this virus, like psittacosis, produces both large forms and elementary bodies and stains with Castañeda's stain. With Giemsa's stain the elementary bodies are stained a colour intermediate between the purple of psittacosis and the red of vaccinia. Both elementary bodies and large forms gave a negative result in our hands.

Some investigators (for example, Herzberg[5]) are doubtful whether psittacosis should be included among the viruses because of the ease with which it stains with dilute Victoria blue and with Castañeda's stain. The fact that it is Feulgen-positive appears to strengthen this distinction; but on the other hand in lymphogranuloma we have a virus which is at once Castañeda-positive and Feulgen-negative, thus forming an intermediate link between psittacosis on one hand and vaccinia on the other.

It will be of interest to apply the Feulgen method to as many viruses as possible, and this we propose to do.

C. F. ROBINOW.
J. O. W. BLAND.

Pathological Department,
St. Bartholomew's Hospital,
London,
Sept. 5.

[1] Stille, B., *Arch. Mikrobiol.*, **8**, 125 (1937).
[2] Piekarski, G., *Arch. Mikrobiol.*, **8**, 428 (1937); *Zbl. Bakt.*, Abt. 1, **142**, 70 (1938).
[3] Haagen, E., *Arch. exp. Zellf.*, **19**, 425 (1937).
[4] Findlay, G. M., Mackenzie, R. D., and MacCallum, F. O., *Trans. Roy. Soc. Trop. Med.*, **32**. No. 2, 183 (1938).
[5] Herzberg, K., *Klin. Wochenschr.*, **15**, 1388 (1936).

Points from Foregoing Letters

THE discovery of a large fragment of an additional *Pithecanthropus* skull (consisting of the complete right parietal bone with the adjoining part of the left parietal and a small piece of the occipital bone) is reported from Java by Dr. G. H. R. von Koenigswald and Dr. Franz Weidenreich. This was found in the Trinil formation of Sangiren, where an almost complete brain case of *Pithecanthropus* was found last year.

A type of sidereal system heretofore unknown is reported by Dr. Harlow Shapley, who has based his investigations on long-exposure photographs made with various telescopes at the South African station of the Harvard Observatory. The two examples now described resemble globular clusters in uniformity and radial symmetry; numerous faint external galaxies seen through them give them the appearance of supergalaxies, but they are probably members of the local supergalaxy.

Dr. L. Jánossy and Dr. A. C. B. Lovell have obtained cloud chamber photographs of cosmic ray showers which extend over several square metres. They conclude that the showers consist mainly of electrons, and that in some cases the total energy of the shower may exceed 10^{10} electron volts.

The magnetic anisotropy of manganite crystals (monoclinic) is found by Prof. K. S. Krishnan and S. Banerjee to be $4{\cdot}0 \times 10^{-6}$ per gm. atom of manganese. This value, the authors state, shows that the manganese atoms in the crystal cannot be trivalent, but are probably half divalent and half tetravalent.

Prof. V. V. Narlikar submits a proof, using the equation of conservation of momentum, that a *radiating* small mass describes a geodesic. He also points out that the constancy of the inertial mass is implicit in the equation of momentum itself when the body is not radiating.

The infra-red absorption and Raman spectra of liquid and gaseous sulphur trioxide have been investigated by Dr. H. Gerding and Dr. J. Lecomte, who deduce that in the vapour state the molecule of sulphur trioxide has a plane, practically symmetrical configuration, while in the liquid state the molecule is considerably deformed.

A reconsideration of the wave-lengths observed in the ultra-violet and visible spectra of the night sky by Prof. J. Cabannes, Prof. J. Dufay and J. Gauzit lead the investigators to the conclusion that CH bands probably exist in the spectrum of the night sky at 4300, 3143 and possibly 4050 A.

A substance obtained by the steam distillation of yeast extract and apparently containing a mixture of saturated fatty acids is found by Prof. E. S. Cook and C. W. Kreke to increase by $3\frac{1}{2}$ times by the respiration factor (oxygen uptake) of yeast suspensions, when added in suitable concentration. Capric and undecanoic fatty acids were found to have similar properties. In the concentrations thus far investigated, the yeast distillate appears to be inhibitory to yeast growth and fermentation, but stimulates the growth of epithelium in tissue cultures.

The free ammonia formed in blood, after shedding, arises from three sources, according to Prof. E. J. Conway and R. Cooke. These sources are (1) adenosine, (2) adenylpyrophosphate in the red corpuscles and (3) vegetable adenylic acid. The authors indicate the probable stages by which the ammonia is formed, and point out that probably the ferment in the red corpuscles and other tissues, except voluntary muscle, is reversibly bound to some inhibiting substance.

Research Items

Craniology of African Pygmies

SKELETONS of four African pygmies, acquired for the Musée de Congo of Terveuren by Dr. P. Schebesta and J. Jadin in their expedition to the Ituri Forest in 1934–35, have been examined by Prof. J. Mateigka and Prof. J. Maly. The first instalment of their report, dealing with the crania, appears in *L'Anthropologie* (**48**, 3–4; 1938). Of these skeletons, two are male and two female. Of the males, one was of about forty years of age; the female from the same locality was about fifty years of age. The skulls were well preserved, and the distinctive sexual characters well marked. There was a marked atrophy of the maxillaries, possibly due to the loss of the teeth, which may also have caused a certain facial asymmetry. Partial caries and alveolar pyorrhea were present. The sutures generally were simple. Head-length varied from 165 mm. to 176 mm., breadth from 128 mm. to 136 mm. This measurement in the male crania (135 mm. and 136 mm.) approaches the mean for Spanish skulls and exceeds that recorded for Australian, Vedda and Bushman. Head height 122–130 mm. is a minimum figure. The dimensions of the skull taken together, however, point to the classification of these pygmy skulls with other groups below the mean. The cephalic index of 73·56–80·47 ranges from dolichocephalic to brachycephalic. They may be classed generally as orthocephalic, with a tendency to metriocephaly. The horizontal circumference ranges from 475 mm. to 498 mm. This indicates that the pygmies do not touch the absolute minimum, as smaller dimensions are found among both primitive and white peoples.

Undulant Fever in France

IN a recent *Bulletin of the Health Organization of the League of Nations* (**7**, Extract No. 9), R. M. Taylor, M. Lisbonne, L. F. Vidal and R. H. Hazemann, who made a study of 869 *Brucella* strains isolated from man and animals in France, came to the following conclusions. All the classified strains of *Brucella* fall into one of two types, namely, *Br. melitensis* and *Br. abortus*. Of 507 strains isolated from man, 477 (94 per cent) were *Br. melitensis*. While the *melitensis* type was definitely dangerous to man, *Br. abortus* was a relatively unimportant cause of undulant fever, and was essentially an economic and veterinary problem. Cases of undulant fever of the *melitensis* type were usually multiple and tended to occur in localized epidemics, while those of the *abortus* variety were almost invariably sporadic. The incidence of undulant fever in France reached a peak in the early spring, which is the period of parturition and abortion among domestic animals such as sheep and goats. As regards age and sex, clinical undulant fever was found to be rare below the ages of fifteen years and was two or three times more frequent in males than in females. Infections in goat and sheep were almost always of the *melitensis* type, whereas cows were the principal hosts of the *abortus* variety. The disease was found to occur chiefly among the rural population and in those who were brought in contact with the animals or their carcasses. The writers' studies indicated that the risk of infection through contact with animals was decidedly greater than through consumption of raw milk or fresh cheese. Sanitary conditions were of little importance in the transmission of the disease.

Aerial Vision in Freshwater Grey Mullet

AERIAL vision in fishes, demanding a modification of the under-water eye, is a rare development, so that the notes by Dr. S. L. Hora upon the freshwater grey mullet of northern India and Burma (*Mugil corsula*) are welcome, although they do not carry the problem very far (*J. Bombay Nat. Hist. Soc.*, **40**, 62, 1938). The species habitually moves at the surface of the waters in which it lives with both its eyes well elevated above the surface. That it can see in this position is indicated by its active capture of caddis-flies, the swarms of which it seems to follow at the surface. Yet the stomach contents of some consisted mostly of large numbers of copepods, and others devoured aquatic algæ, so that the fish can apparently see under water as well as in the air. Hora also noted that in both media the eye-balls showed movements "in all directions", as if they were in active use. But no experiment has been made to test the efficiency of the organ in either medium; and except that the grey mullet has no structural adaptation like that of the South American "four-eyed fish", *Anableps*, with its bifocal vision, no information is given about the minute structure of the eye itself, to suggest the direction of the aerial modification. Information on these points would be of value.

Genetics of Millet and *Sorghum*

MILLET (*Panicum miliaceum*) has been grown from the earliest times in India, Africa, southern Europe, China and Japan. Its home may have been in central Asia, where nomad peoples found it useful because of its short period of maturation. Mr. Rangaswami Ayyangar and his colleagues have studied its genetics (*Madras Agric. J.*, **26**, 195; 1938) at Coimbatore. They find a dominant factor *P* for purple pigmentation, and an intensifier, *I*, which makes the purple darker. The hairiness is governed by at least three factors, H_1, H_2, H_3, which are cumulative in effect. In grain colours of Madras varieties, a dominant factor *O* changes buff to olive grey. A dominant factor *L* lightens the glume colour. An inhibitor *I* lightens it further to ivory. A third grain colour, reddish-orange, is recessive to buff, while another dominant factor suppresses the red in reddish-orange, making it buff. A number of species of *Sorghum* are found (*Current Sci.*, **6**, 556) to have varieties with green and others with blue-green seedlings, the latter tillering more. This colour disappears after forty days and behaves as a dominant to green. The African species of *Sorghum* and their hybrids appear to be the origin of the blue-green type, which is also found to occur in many other grasses. In broom-corn, a *Sorghum* with long stalks to the panicle branches, a form occurs with neither auricle nor ligule to the leaves. It is a simple recessive to the auriculate-ligulate condition (*Proc. Indian Acad. Sci.*, **7**, 286),

and also differs in having no basal pulvini and a short spikelet-free area in the panicle branches. This makes the earhead very compact with many sterile seeds. It presumably represents a mutation from the ordinary broom-corn condition.

Constitution of the Great Barrier Reef

THE Reports of the Great Barrier Reef Committee, 4, Pt. 3, Nos. 7, 8, 9 (Brisbane: Gov. Printer, 1938) contain a preliminary account by Prof. H. C. Richards on the boring made in 1937 on Heron Island (lat. 23° 26′ S., long. 151° 57′ E.) at the southern end of the Great Barrier Reef. This bore followed on a previous boring made in 1927 on Michaelmas Cay some 700 miles farther north-west along the reef. The Michaelmas Cay boring failed to reach the underlying old rock platform after a depth of 600 ft. It was hoped to bore to 1,200 ft. on Heron Island. Unfortunately, layers of rock were encountered below 510 ft. which necessitated reductions in the size of the casing, and the extreme depth reached was 732 ft. Once again the bed rock was not reached. Comparison of the two borings shows a remarkable similarity. In both it was found that loosely coherent coralline material extends to a depth of approximately 450 ft. In both this was succeeded by non-coralline material of loosely coherent quartz sand with abundant foraminifera and littoral shell fragments. In the Heron Island bore eight siliceous foraminiferal limestone bands were met below the coral, of which the thickest was 78 inches, four were of the order of 18 inches to 2 feet, and the others quite thin.

Oxidation and Reduction

IN an article in *Scientia* of September 1938, Prof. J. R. Partington reviews the early history and modern outlook upon the processes of oxidation and reduction, and in particular the application of the oxidation-reduction potentials, now generally known as 'redox' potentials, to modern problems. Incidentally, he points out the curious resemblance between the electronic theory of oxidation and the ancient theory of phlogiston. Metals are now believed to be combinations of positively charged ions and negative electrons, of which the former persist in oxides and cations. The process of oxidation involves then the removal of electrons instead of phlogiston. It may be noted in this connexion that those metals which are most readily oxidized are those which most readily emit electrons when exposed to light of short wave-length. In applying the well-known thermodynamic equation to the evaluation of the redox potential of an electrode of the quinhydrone type, it was assumed by Ostwald that every reducing or oxidizing agent could be replaced theoretically by hydrogen or oxygen under an appropriate pressure, and Nernst obtained some experimental support for this supposition by pumping hydrogen gas from a thin bulb of palladium immersed in a solution of a reducing agent. But since reversible cells giving redox potentials can be set up with solutions of metallic salts in anhydrous solvents like pyridine or acetonitrile, which are unable to furnish hydrogen, some other mechanism must be found, and it is reasonable to postulate the presence of low concentrations of free electrons not only in these but also in all cases, to establish the potential. Increasing use of redox indicators is being made with marked success in analytical chemistry, since they undergo reversible changes which are very similar in type to those of the quinhydrone electrode and are accompanied by colour changes at definite potentials, corresponding with definite electron concentrations in the redox system. Even more interesting is the field opening up in the study of biological processes, which involve oxidation and reduction and are catalysed by specific enzymes. It is hoped that it may be possible to extend the use of 'potential mediators' in order to overcome the difficulty presented by the thermodynamic irreversibility of many of these important reactions. Much remains to be done in developing the study of one of the oldest known types of chemical reaction.

Search for Super-Novæ

F. ZWICKY (*Phys. Rev.*, **53**, 1019) has published a preliminary account of a systematic study of super-novæ. The basis of the work was a photographic survey with an 18-in. telescope of aperture *f*/2. Three super-novæ were discovered, corresponding to a frequency of occurrence of one nova per galaxy per six hundred years. It was shown that the spectra are distinct from those of all other stellar objects and that the absolute brightness may often be far higher than that of any other star. It is concluded that the existence of two classes of temporary stars, the ordinary- and super-novæ, is established beyond doubt.

Draining the Cambridge Fens

THE greater part of the fenlands of northern Cambridgeshire were drained during the first half of the seventeenth century. The enterprise was very successful at first; but difficulties soon began to become evident, some of which have continued to be prominent right up to the present day, as was shown in a paper read at Cambridge before Section E (Geography) of the British Association by Dr. H. C. Darby. These permanent difficulties are associated with the lowering of the peat-level and with the outfalls of the fen rivers. As the peat was drained, it rapidly sank in level partly owing to shrinkage and partly to the wasting away of its surface by bacterial action, so that in time its level became lower than that of the drainage channels. This difference of level may be seen to-day along many of the fen rivers, which are now higher than the land through which they flow. In the eighteenth century, windmills were introduced; but as the surface-level continued to subside, their limitations made them inadequate to the requirements. In 1800 steam pumping was discussed, but it was not until 1820 that a steam engine by Watt was set up to work a scoop wheel at Bottisham. Thirty years later it is estimated that sixty-four steam plants were in operation. Difficulties have also arisen at the estuaries of the fenland rivers, which have not a sufficient current to carry their silt out to sea. The most recent effort to deal with this problem is the large-scale working model of the Wash and its estuaries constructed by the Great Ouse Catchment Board. Another type of problem is presented by the sluices which are necessary to prevent the tidal waters from passing up the rivers. A case in point is Denver Sluice, immediately below which the Hundred Foot River drains directly into the tidal Ouse. When there is much upland water passing down this river, the level in the Ouse does not fall sufficiently to admit of the sluice gates being opened, with consequent risk of flooding.

Function of Education

THE discussion on "Education for a Changing Society" arranged by Section L (Educational Science) of the British Association on August 19 and 22 was maintained at a high level well worthy of the crowded audiences which it attracted.

In opening the discussion, Mr. W. H. Robinson dealt with the senior school, which he described as pre-eminently the school of the people, the vast majority of the electorate. Most of the pupils of the senior school would receive no further organized education but would be educated by their environment, both physical and mental. He suggested that the essential function of school in a changing society is to teach pupils the art of self-education to be continued through life, and to give them a conviction that education is not a thing of school alone. The school should provide a connecting thread running through the educative influence of the cinema, radio, picture paper and environment generally. Accordingly, the school must be related at all points to the community and, as the Hadow Committee insisted, the curriculum must be thought of in terms of experience and activity rather than of knowledge to be acquired and facts to be stored.

The years from eleven to fifteen, Mr. Robinson urged, should be used to consolidate the training already given, by taking into full account the psychology of the adolescent of this age. By becoming leaders of the school community, by experience of the organization of school activities, by discussion and attempts at agreement, they would learn by experience the basic facts on which our democracy is based and the lines along which it must develop. In this way they would learn the necessity for patience, persuasion and compromise, respect for the opinions and form of action of others, and that toleration is better than coercion. This learning through experience, Mr. Robinson considers, is more important than lessons, and the great need appears to be for the development of a technique for developing the active co-operation of the pupil in the work of self-education for life.

The second paper, by Miss Ruth Dawson, also dealt with the senior school, and emphasized the importance, in view of the background and environment of the modern child, of giving an education designed not to accumulate facts but to train the mind to make right judgments. Once again reference was made to the aims set forth in the Hadow Report and the importance of all subjects in the curriculum contributing to the formation and strengthening of character, the training of tastes which would fill and dignify leisure, and to the awakening and guiding of intelligence. Miss Dawson referred in illustration to the use and opportunities of physical training, domestic science, arts and crafts, drama, etc.

The part of the secondary school was discussed in papers by Dr. P. T. Freeman and Miss Muriel Davies which presented two opposite, but not necessarily opposed, points of view and were afterwards rather severely criticized by Mr. H. G. Wells. Dr. Freeman stressed the importance of discipline and urged that it is necessary not only to arouse interest but also to demand effort. He deplored the recent agitation against homework and said that, in spite of the independence of the modern child, there is a lack of vitality and willingness to tackle difficulties. Dr. Freeman urged the value of Latin and Euclid in training, particularly as teaching children not to accept statements without adequate evidence. He advocated a three-year course in biology as a means of conveying information about sex and, while supporting an extension of the teaching of civics and economics, considers that over-emphasis on apparatus in physical training is dangerous. Although he was severely taken to task by Mr. Wells for his advocacy of Officers' Training Corps, his opinion of the value of such training in developing not only discipline but also self-reliance will certainly find strong support.

Miss Muriel Davies, on the other hand, devoted much of her time to an analysis of social conditions and of the way in which inequalities are perpetuated in our present educational system. She pleaded eloquently for a unification of our educational system particularly in the ranks of the teacher, the abolition of distinctions in salary scales between elementary and secondary school teachers, and the evolution of a system of education for social progress rather than for individual advancement. Miss Davies's address contained many almost startling suggestions, designed to promote co-operation rather than competition and to break down class distinctions, such as the abolition of formal hours and holidays, the education of rich and poor together, the requiring of all teachers to spend some time in elementary schools; but the vision and idealism of the address warmly commended it to the large audience, not the less because it was constructive and forward looking. She deprecated the use of prizes and marks for stimulating effort, but although she advocated more freedom of choice for children in their actual work both in and out of the school, her insistence on the encouragement of the community spirit and suggestion for a group system in place of the house or house prefect system should have safeguarded her from Mr. Wells's stricture.

Continuing the discussion on August 22, Mr. J. Paley Yorke dealt with the functions and work of the junior technical school, the importance of which is enhanced by the decay of the apprenticeship system. He laid particular stress upon the importance of the staff possessing adequate industrial experience in view of its bearing on the content and presentation of the training. Dr. W. A. Richardson discussed the place of the technical college. Pointing out the disparity between our knowledge of the material world and our knowledge of mind and social relations, he stressed the need for research in the latter field. Social conditions profoundly affect the work of technical colleges, as of all education and educational ideals, and Dr. Richardson instanced the danger that the rearmament programme will have untoward effects in the educational field. There are wide differences between technical colleges, and the voluntary system has a serious defect in the leakage of students, many of whom do not stay the course. Moreover, difficulties also arise because often the students attend primarily for training in occupations

other than that which they are following at the moment. There is less leakage of students entering technical colleges from the junior technical schools than of students of any other type.

Dr. Richardson considers that the raising of the school age would assist the work of the technical colleges; but if education is to be effective, it must be compulsory until the age of mental maturity—at least until eighteen. The idea of the local college, which is a community of students whose main purpose in attending is educational, and not social, but for whom the authorities must provide facilities for social and physical development in the fullest sense, is gaining ground. Such colleges would necessarily continue to have a vocational and industrial bias, endeavouring to develop skill as well as to impart technical knowledge and training in administration both in the industrial and the civic sphere.

Mr. F. Pick, whose paper drew the warm approval of Mr. H. G. Wells, criticized education for failing to give to the new subjects of an industrial civilization the breadth and quality which is given to the older subjects bred in the classic ages. He argued for a new type of university of the eye and hand as distinct from that of the voice and the pen. It should be possible to illuminate the accumulated knowledge of trade and industry with a wisdom and understanding which would make it a suitable medium for a liberal education. The trained and broadened mind should be applied to the building up out of the mass of knowledge which they embody, human sciences to rank with ethics, politics, economics and sociology.

Prof. Winifred Cullis followed with a final paper in which she dealt with some questions confronting the universities in the changing world. With regard to the aims of university education, there is a great consensus of opinion as expressed both by staff and by students, and the stress is laid on training for living rather than for a livelihood. She referred to a number of particular problems raised in recent reports, such as the question whether a specialist training for particular careers is the best for developing leaders of informed public opinion, for men and women who are to be politicians, administrators, journalists or teachers. Again, there is the question whether post-graduate teaching should be concentrated in particular universities, in which connexion Prof. Cullis referred to the backward position of post-graduate education in medicine in Great Britain compared with that in other countries. The extension of the system of individual tutorship to all universities, and increased facilities for short-term exchanges of staff between different universities both in Great Britain and abroad, and the provision of increasing numbers of residential halls are all matters requiring consideration.

Prof. Cullis laid particular stress on the importance of greater attention to the question of the health of students, and strongly supported the demand for physical education and health services at the universities. She is in favour of compulsory medical examinations at regular intervals, pointing out that it is often the students who can least afford medical advice who most need it and that such examination could often prevent serious illness developing later. She outlined a number of health insurance schemes, both optional and compulsory, which have been developed for students in Great Britain or abroad, and finally stressed the importance of including training for the responsibilities of citizenship.

Lord Stamp, who opened the discussion, was decidedly more critical than Mr. H. G. Wells of Mr. Pick's paper. He pointed out that we cannot say what changes in education are desirable until we have decided what is the right direction for such changes to take; what is the optimum speed at which they should be made; how they can be made with the least waste; and what should be the correct agencies for bringing them about. Some account must now be taken of the changes in the rate of growth of the population and of its possible physical obsolescence, and Lord Stamp referred particularly to the importance of considering training which would give the right outlook and background to those occupying the intermediate executive positions, since they have so much influence on the selection from the younger men and women of those who in later life will occupy the positions of highest responsibility. He strongly supported the idea of refresher classes and post-graduate courses for those already occupying business or professional posts. Sir Richard Livingstone criticized the teaching of history and philosophy at an age too early for adequate appreciation, and expressed his regret that adult education had not been included in the discussion.

New Science Buildings at Shrewsbury School

On September 24, Sir William Bragg, president of the Royal Society, opened the new science building at Shrewsbury School. Charles Darwin was at the School from 1818 until 1825, and the building, hitherto used for science teaching, erected in 1903, was named after him. It has been considerably re-modelled and improved for chemistry teaching under the present building programme. The new building was dedicated "in thankful commemoration of the life and work of Charles Darwin".

The new science building comprises two floors, the ground floor being devoted to physics, and the first floor to biology. The latter floor is some two thirds the area of the ground floor and is masked on three faces by roof slopes, it being the desire that this new building should conform to the general style of adjacent buildings, which are mostly of one story. The construction is of brick, with hollow tile fire-resisting floors, and tiled roofs with asphalt flats between. All rooms are fully plastered, and floors generally are of teak blocks. Heating is by low-pressure hot water radiators.

The ground floor (physics) has two large elementary laboratories, each for 26 students, with a common preparation — store room, an advanced laboratory for 16 students, two lecture rooms to seat 26 each, a large store room and a photographic dark room. Both elementary laboratories are alike in fitments; long fixed double-sided table type benches, having gas and electric services, occupy the middle of the room. Enclosed balance cases in groups are disposed around the walls, and two large sinks are

conveniently situated in each room. The advanced laboratory is fitted with a 'service shelf' 15 in. wide around three sides of the room (having gas, water and electric services thereon), which when used in conjunction with the four strong loose tables gives considerable flexibility.

The elementary laboratories and lecture rooms contain fully equipped demonstration benches, and a certain amount of local storage is provided in all rooms. All rooms have dark blinds. Free wall space is fitted with battens for fixing and hanging apparatus, and the laboratories have beams suspended from the ceiling for the usual physical experiments. Built-in slate galvanometer shelves are provided in convenient positions, those in the lecture rooms having measuring leads and 12-volt light leads connected to the demonstration benches for demonstration work with mirror galvanometer and ground glass scale.

Large yellow glass 'boards' (in place of the more usual blackboards) have been used throughout. Experimental electrical services consist of switch plugs to all working spaces, which in the elementary laboratories can be used on the 230 volts A.C. supply or alternatively on 12 volts A.C., one pair of leads only being used (designed to avoid varying voltage drops). Voltage reduction is by 'step-down' transformer and change-over switch under the supervision of the master. Direct current supplies for the advanced laboratory and all demonstration benches at 24 volts is provided from a battery of cells and an oxide cathode rectifier, interchange of voltage being carried out by plug and socket distribution board arrangement. All the D.C. equipment is located on one wall of the advanced laboratory and is available for instructional purposes.

The first floor (biology) consists of two very large well-lighted laboratories, a common preparation room, store room, greenhouse, and a small private research room for the masters' use. Except for incubator accommodation in one room and aquaria in the other, both large laboratories are identical in fitments, one portion of each room being laid out with flat-topped tables and seats for 24 students (for theoretical work), with fully equipped demonstration bench, projection screen, and 'yellow board', the other portion fitted with low benches (for 28 students) for microscope and dissecting work. These latter benches have gas points and microscope light points fitted, and are designed to accommodate microscopes and their lamps when not in use. There are two large wash-up sinks and drainers in each laboratory, with provision for draining and storing dissecting boards, and around all walls one continuous shelf allows of the display of natural history specimens and specimens 'in embryo'. North-east top lights are provided over that part of each laboratory devoted to practical work, and dark blinds are provided throughout. Storage and preparation rooms provide accommodation graded to suit all sizes from small stain bottle racks to large diagram charts.

The old building has been considerably re-modelled internally to provide the necessary accommodation exclusively for chemistry, comprising two large elementary laboratories (one for fifth-form work), two large lecture rooms, an advanced (specialist) laboratory for 14, two balance rooms, the usual store and preparation rooms and a small science library. Existing fittings have been modernized, new chemistry working benches provided where necessary, and new ranges of fume cupboards in the fifth-form laboratory and advanced laboratory have been installed, ventilated by a centrifugal fan and acid-resisting ducting. New roof lights have been added to improve the natural lighting of the rooms.

The architects for the work were Messrs. Munby and Smith, of 9 Old Square, Lincoln's Inn, London.

Effect of Inbreeding of Physiologic Races of Rust

THE recognition of the + and − strains in rust fungi and the way in which the bi-nucleate aecial condition must be preceded by mycelial fusion of + and − strains or the introduction of pycniospore-containing nectar of the opposite strain, has led to the possibility of the study of inbred physiologic races. Johnson and Newton (*Can. J. Res.*, **16**; 1938) have made a study of the effects produced in *Puccinia graminis Tritici* Erikss. and Henn. Cultures have been started from a single urediospore and these have been followed through their cycle, selfing being brought about by mixing pycniospore-containing nectar of pustules of the isolated race.

It is found in several of the isolated races, when selfing has been repeated for several generations, that new features are liable to appear. Thus races which originally had the normal red uredial colour have produced types with greyish-brown, orange or white uredia—features which are of extremely rare occurrence in Nature. The proportions in which these abnormalities of uredial colour appear suggest a genetic relation in which greyish-brown and orange are dominant to white, and the normal red to the other three.

Also in such inbred races types have appeared with decreased vigour of uredia as evidenced by a tendency towards or failure of the uredial pustules to break through the host epidermis; other types have shown a weakening of pathogenicity, as compared by inoculation of named varieties of wheat, and still others have failed to produce aecia and instead formed urediospores or teliospores on the barberry.

The authors point out that mutations have been reported several times for the rusts, and the evidence from the present work suggests that certain physiologic races are in a mutable condition. Owing to the multiplicity of physiologic races and the heterothallic nature of the rusts, in Nature the mutants will seldom occur in the homozygous condition. When inbreeding is maintained for several generations, it is probable that homozygous recessive types are segregated (or possibly additional mutations occur during the selfing stages on barberry).

In the group of the rusts, short-cycle forms are of relatively common occurrence and may tend towards the production of autoecious species. In this connexion it is of interest to find in *Puccinia graminis* a mutant in which the aecial stage is eliminated, though the urediospores produced on the barberry are only capable of infecting wheat seedlings, so that the physiologic race is still heteroecious.

Science News a Century Ago

Fermentation an Act of Vegetation

"M. TURPIN has lately published his observations upon certain phenomena, which he considers sufficient to show, that the act of fermentation, concerning which chemists have been so much embarrassed, is owing to the rapid development of infusorial plants. He states, that all yeast, of whatever description, derives its origin from the separation from organic tissues, whether animal or vegetable, of spherical particles of extreme minuteness, which particles, after a certain time, rise to the surface of the fluids in which they are immersed, and there germinate. . . . . No doubt the yeast of beer consists of minute molecular matter, the particles of which are globular; and that these particles produce, from their sides, other particles like themselves, which eventually separate from the parent, but we do not know that they are *therefore* plants" (*Athenæum*, October 20, 1838).

Smoke Abatement

THE *Mechanics' Magazine* of October 20, 1838, when describing a plan by Iveson for effecting the combustion of smoke, which had been tried in the steamer *Royal Adelaide*, remarked: "Smoke has always been regarded as a nuisance. As the age of steam advanced, and as its benefits were extended over, and enriched the face of the earth, so did the concomitant evil, smoke, throw a cloud abroad which bade fair to obscure the face of the sky. So great became the evil, that in process of time every one not directly interested in its cause complained aloud, and seemed willing to forego the grand effects of the steam-engine rather than put up with its smoke. Petition after petition poured into the Houses of Parliament praying the legislature to compel the manufactories to put out their fires or swallow their smoke. Learned societies offered premiums to incite their members to search for an antidote. . . . A parliamentary committee was appointed to examine into the subject. . . . An Act was the result of this inquiry rendering manufacturers indictable for a nuisance if the smoke of their chimneys annoyed their neighbours."

The Transatlantic Steamship *Liverpool*

ON October 20, 1838, the S.S. *Liverpool*, the largest vessel built on the banks of the Mersey up to that time, sailed from Liverpool on her maiden voyage to New York. Her length was given by the Surveyor of Lloyd's Register of Shipping as 218 ft. 4 in., her breadth 31 ft. 4 in., her tonnage by builders' measurement 1,042$\frac{3}{94}$ tons, and her steam-boat tonnage 559$\frac{1}{2}$ tons. She was not originally intended for work on the Atlantic, and to strengthen her for the passage she was fitted with iron beams over the engine and boiler rooms, and these beams were braced together with fore and aft iron rods. Other iron rods were used to strengthen the paddle boxes. She had a two-cylinder side-lever engine of 468 horse-power, the steam pressure being about 5 lb. per sq. in. Leaving Liverpool on October 20, when six days out it was realized that her coal would not last the voyage, so she returned to Cork to refill her bunkers. Sailing again from Cork on November 6, she reached New York in 16 days 17 hours, her best day's run being 242 miles. Between October 1838 and the end of 1840, she crossed and recrossed seven times.

Societies and Academies

Paris

Academy of Sciences (*C.R.*, 207, 385–412, August 17, 1938.)

E. ESCLANGON: The sixth congress of the International Astronomical Union held at Stockholm on August 3–10, 1938.

E. C. G. STUECKELBERG: Interaction between elementary particles.

H. PAILLOUX: A property of certain fluid movements.

Y. HAGIHARA: Reduction of differential equations in the problem of n bodies.

R. GUILLIEN: Variation of the dielectric constant at solidification of homopolar liquids. Work on toluene, metaxylene, carbon tetrachloride and liquid nitrogen, when solidification is slow, shows that the dielectric constant increases.

J. LECOMTE: Comparison of the infra-red absorption spectra of heterocyclic compounds and of nuclear hydrocarbons.

MLLE. G. CHAUVENET: Influence of radius of curvature on the speed of oxidation of cobalt.

H. HUBERT and J. BARBERON: Preliminary study of atmospherics by means of a cathodic oscillograph.

R. GUIZONNIER: Behaviour of the semi-diurnal variation of the earth's electric field, when the phase of the diurnal component is perturbed.

R. GAUTHERET and P. DELAPORTE: Statistical researches on the survival of the root-cap cells of *Lupinus albus*. These cells can survive in culture under a variety of conditions and it is easy to distinguish between living and dead cells. Mortality follows the 'Law of Facility' of Galton and MacAlister.

MLLE. G. MOUROT: The ultimate terms of purine metabolism in mammals.

H. SCHWAB: Modifications in the hypoglycæmia due to insulin and to adrenaline caused by the addition of salts of nickel, of iron and of copper. The effects of these salts are sufficiently alike to show that their action is non-specific.

(*C.R.*, 207, 413–436, August 22, 1938).

E. JOUGUET: Remarks on Dunkerley's formula.

A. GUILLIERMOND and R. GAUTHERET: Fixation by living vegetable cells of the leucobases of certain vital colouring matters.

G. WATAGHIN: A generalization of relativist transformations.

J. CICHOCKI and A. SOLTAN: Radiosilicon produced by bombardment of sulphur with fast neutrons.

F. FRANÇOIS: Study of the system mercuric iodide – mercuric bromide – absolute alcohol, and evidence of a mercuric bromo-iodide obtained by the Raman effect.

J.-J. TRILLAT and A. AUBRY: Study of oil refining by means of a photographic method.

H. GAULT and J. SKODA: Researches on the condensation of acyclic aldehydes with certain compounds containing the carbonyl group. Condensation of formic and acetic aldehydes with cyclopentanone.

R.-PH. DOLLFUS: Evolving cycle of a trematode of the genus *Coitacæcum* W. Nicoll. Progenesis of the metacercarian larva in the amphipods.

S. CHEVAIS and A. G. STEINBERG: Relation between the concentration of the extract of *Calliphora* and the number of facets in the eye of the bar mutant of *Drosophila melanogaster*.

Forthcoming Events

[Meetings marked with an asterisk are open to the public.]

Tuesday, October 18

Eugenics Society (at the Royal Society), at 5.15.—Dr. J. A. Fraser Roberts: "Intelligence and Family Size".*

Wednesday, October 19

Society for the Study of Alchemy and Early Chemistry (at University College, London), at 8.—Dr. R. J. Forbes: "Bitumen and Petroleum in Antiquity".*

Thursday, October 20

London School of Hygiene and Tropical Medicine, at 5.30.—Prof. H. Cramér: "Problems Connected with the Analysis of Statistical Times Series" (succeeding lectures on October 21 and 24).*

Institution of Electrical Engineers, at 6.—Dr. A. P. M. Fleming: Inaugural Address.

British Institute of Radiology, at 8.—W. E. Schall: "British Radiology in the Future" (Presidential Address).

Friday, October 21

Institution of Mechanical Engineers, at 6.—D. E. Roberts: Presidential Address.

Appointments Vacant

Applications are invited for the following appointments, on or before the dates mentioned:

Metallurgist under the Director of Scientific Research, War Office—The Permanent Under-Secretary of State for War (C.4), War Office, London, S.W.1 (October 17).

Assistant (grade I—physics) at the Chemical Defence Experimental Station, Porton—The Chief Superintendent, Chemical Defence Research Department, 14 Grosvenor Gardens, London, S.W.1 (October 26).

Technical Assistant in the Chemical Section, Research Station, Long Ashton, Bristol—The Director (October 27).

Senior Meteorological Officers in the Department of Industry and Commerce, Eire—The Secretary, Civil Service Commission, 45 Upper O'Connell Street, Dublin (October 28).

Principal of the Rutherford Technical College, Newcastle-upon-Tyne—The Director of Education, City Education Office, Northumberland Road, Newcastle-upon-Tyne, 2 (October 29).

Technical Officer and Assistants (grade II) in the Meteorological Office—The Under-Secretary of State (S.2.A.), Air Ministry, Adastral House, Kingsway, W.C.2 (October 31).

Lecturer in Chemistry in the University of Cape Town—The Secretary, Office of the High Commissioner for the Union of South Africa, Trafalgar Square, London, W.C.2 (November 5).

Lecturer in Physics in the School of Science, Khartoum—The Controller, Sudan Government London Office, Wellington House, Buckingham Gate, London, S.W.1 (November 10).

Assistant Keeper in Geology in the British Museum (Natural History), London, S.W.7—The Secretary (December 1).

Professor of Aeronautics in the University of Sydney—The Secretary, Universities Bureau of the British Empire, 88A, Gower Street, London, W.C.1.

Assistant Lecturer and Demonstrator in Zoology in King's College of Household and Social Science, Campden Hill Road, London, W.8—The Secretary.

Reports and other Publications

(not included in the monthly Books Supplement)

Great Britain and Ireland

Department of Scientific and Industrial Research. Index to the Literature of Food Investigation. Vol. 9, No. 4, March 1938. Compiled by Agnes Elisabeth Glennie, assisted by Gwen Davies. Pp. v+281–422. (London: H.M. Stationery Office.) 4s. 6d. net. [279

East African Agricultural Research Station, Amani. Tenth Annual Report, 1st April 1937—31st December 1937. (Colonial No. 151.) Pp. 40. (London: H.M. Stationery Office.) 1s. net. [289

University of Bristol and Wiltshire County Council. An Agricultural and Soil Survey of the Bromham District of Wiltshire. By A. W. Ling, W. T. Price and L. D. C. McLees. Pp. 28+xv. (Bristol: The University.) 2s. 6d. [289

Forest Bibliography to 31st December 1933. Part 3, C: Forest Protection. Pp. iv+201–274. (Oxford: Department of Forestry, The University.) 12s. 6d. [410

British Electrical and Allied Manufacturers' Association. Some Information. Eleventh (new and revised) edition. Pp. 46. (London: British Electrical and Allied Manufacturers' Association.) Free. [410

Other Countries

Cornell University: Agricultural Experiment Station. Bulletin 690: The Black-Spot Disease of Roses, and its Control under Greenhouse Conditions. By E. W. Lyle. Pp. 32. Bulletin 692: The Silver-Scurf Disease of Potatoes. By O. D. Burke. Pp. 30. Bulletin 696: Economic Studies of Dairy Farming in New York. 13: 100 Grade A Farms in the Tully-Homer Area, Crop Year 1936. By E. G. Misner. Pp. 60. Bulletin 698: Economic Studies of Dairy Farming in New York. 14: Factors affecting Premiums received in Grade-A-Milk Production. By E. G. Misner. Pp. 28. Bulletin 699: The Influence of the Central Rural School on Community Organization. By Eugene T. Stromberg. Pp. 40. Bulletin 700: An Economic Study of the Marketing of Western New York Potatoes by Motor Truck. By P. J. Findlen. Pp. 52. Memoir 212: Determination of Stringiness in Celery. By Denzel S. Curtis. Pp. 20. Memoir 213: Some Interrelationships between Soil Characteristics, Water Tables, Soil Temperature, and Snow Cover in the Forest and adjacent Open Areas in South-Central New York. By J. N. Spaeth and C. H. Diebold. Pp. 76. Memoir 214: Investigations in Plot Technic with Small Grains. By H. H. Love and W. T. Craig. Pp. 26. (Ithaca, N.Y.: Cornell University.) [289

Tanganyika Territory: Department of Lands and Mines, Geological Division. Bulletin No. 10: Explanation of the Geology, Degree Sheet No. 1 (Karagwe Tinfields). By G. M. Stockley and G. J. Williams. Pp. 96+6 plates+3 maps. 5s. Short Paper No. 19: The Geology of the Country around Mpwapwa. By Dr. B. N. Temperley. Pp. 61+6 plates+1 map. 4s. Annual Report, 1937. Pp. 31. 1s. 6d. (Dar es Salaam: Government Printer.) [289

Tanganyika Territory: Department of Agriculture. Pamphlet No. 20: Sisal Experiment Station Report for the Year 1937. Pp. 29. 6d. Pamphlet No. 21: Reports from the General Experimental Farms, 1937. Pp. 40. 1s. Annual Report, 1937. Part 1. Pp. 46. 2s. 6d. (Dar es Salaam: Government Printer.) [289

British East African Meteorological Service. Annual Report for the Year 1937. Pp. 42. (Nairobi: Meteorological Service Press.) [289

The Rockefeller Foundation: International Health Division. Annual Report, 1937. Pp. vi+243. (New York: The Rockefeller Foundation.) [289

Veröffentlichungen des Geophysikalischen Instituts der Universität Leipzig. Zweite Serie: Spezialarbeiten aus dem Geophysikalischen Institut und Observatorium. Band 9, Heft 3: Die 10 tägige Luftdruckwelle im Sommer 1934 und ihre Dämpfungserscheinungen. Von Rolf Pfau. Pp. 219–272. Band 9, Heft 4: Singularitäten der Zyklonenfrequenz in einzelnen 5°: 10°-Feldern. Von Gertraud Richter. Pp. 273–322. Band 9, Heft 5: Geomagnetische Untersuchungen in Nordwest-Sachsen und Nordost-Thüringen. Von Robert Lauterbach. Pp. 323–368. Band 10: Bericht zur 25-Jahr-Feier des Geophysikalischen Instituts der Universität Leipzig Das Geophysikalische Observatorium. Von L. Weickmann, P. Mildner, H. Lettau, G. Fritzsche, R. Lauterbach. Pp. 172. Band 10, Anhang 2: Das Horizontaldoppelpendel. Von Heinz Lettau. Pp. 83–142. Band 11, Heft 1: Untersuchungen über die Meteorologie der Staubatmosphäre. Von Martin Rötschke. Pp. 78. Band 11, Heft 2: Symmetriepunkt und Wetterkartensymmetrie. Von Fritz Model. Pp. 79–152. Band 11, Heft 3: Über die Existenz langsamer Luftdruckschwingungen auf der rotierenden Erde. Von Walter Wünsche. Pp. 153–200. (Leipzig: Geophysikalische Institut der Universität.) [289

Die in den Jahren 1931 bis 1935 in Leipzig und im Observatorium am Collmberg aufgezeichneten Erdbeben: IV Bericht der Erdbebenwarte des Geophysikalischen Instituts der Universität Leipzig, zugleich letzter Bericht dieser Serie. Von L. Weickmann und P. Mildner. Pp. 205–346+4 plates. (Leipzig: S. Hirzel.) [289

10 Jahre Institut für Chemische Forschung (Kaiserliche Universitaet Kyoto), 1925–1935. Pp. iv+185. (Kyoto: Imperial University.) [309

Hong Kong Nature Series. Orchids, First Twenty. By G. A. C. Herklots. Pp. 62+15 plates. Flowering Shrubs and Trees, First Twenty. By G. A. C. Herklots. Pp. 34+13 plates. Flowering Shrubs and Trees, Second Twenty. By G. A. C. Herklots. Pp. 45+11 plates. (Hong Kong: The Author, The University.) [410

Common Marine Food-Fishes of Hong Kong: 40 Species described in English and Chinese (with European and Chinese Recipes). By G. A. C. Herklots and S. Y. Lin. Pp. 75. (Hong Kong: The Author, The University.) [410

Report of the Aeronautical Research Committee, Tôkyô Imperial University. No. 165: On the Mechanism of Emitting Singing Sounds from Revolving Marine Propellers. By Kôzi Satô and Yutaka Kohasi. Pp. 273–298. 45 sen. No. 166: Performance Calculations on the Kôken Long-range Monoplane. By Hidemasa Kimura. Pp. 299–386. 1.35 yen. No. 167: On the Transition from Laminar to Turbulent Flow in the Boundary Layer of a Sphere. By Susumu Tomotika and Isao Imai. Pp. 387–424. 55 sen. (Tôkyô: Kôgyô Tosho Kabushiki Kaisha.) [410

Pasteur Institute of India. The Thirty-sixth Annual Report of the Director of the Institute for the Year 1936, Part 2. Pp. 48. (Kasauli: Pasteur Institute of India.) [410

Indian Central Cotton Committee: Technological Laboratory. Technological Bulletin, Series A, No. 43: Suitability of Two Cottons for Purposes of Mill Mixings in relation to their Fibre Characters. By Dr. Nazir Ahmad and Dr. K. R. Sen. Pp. ii+28. (Bombay: Indian Central Cotton Committee.) 1 rupee. [410

Year-Book of the Royal Asiatic Society of Bengal. Vol. 2, 1936. Pp. 229. (Calcutta: Royal Asiatic Society of Bengal.) 5.10 rupees. [410